# PUBLIC WORKS

*Devoted to the interests of the engineers and technical officials of the cities, counties and states*

JANUARY, 1940

VOL. 71. NO. 1

A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Asso. Editor

## Contents



## TIMEWASTERS

**Too Late:**

Requests from all over the country for the address of that bank teller that pays $32.14 for a $14.32 check. We figure that it now being past Christmas, the emergency is over, so why bother the poor fellow any more. Summed up nicely by Walter Wheeler with "Better than ham-and-eggs and almost as good as the Townsend Plan." Also, Mr. Wheeler warns that anyone that changed his shirt every day up in New Hampshire would wind up with pneumonia and wouldn't need all of his *eleven* shirts.

**Football Coach Special:**

A ball carrier breaks loose from scrimmage on his opponent's 40-yard line and runs parallel with the axis of the field at a rate of 5 yards a second. The only opponent tackler set to follow him is 20 yards away and directly on one flank. This tackler always runs toward the ball-toter at a speed of 6 yards per second. Consider the velocities uniform throughout and the tackling contact without momentum or drag. DID THE BALL CARRIER MAKE A TOUCHDOWN? And how far did each man travel? Many thanks, *Mr. Conklin,* it was nice to hear from you again.

**A Fish Story:**

Tom caught a fish, which had a head 9 inches long, and a tail that was as long as the head and half the body, and a body that was as long as the head and the tail together. How long was the fish? With thanks to *Link-Belt News.*

*W. A. H.*

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

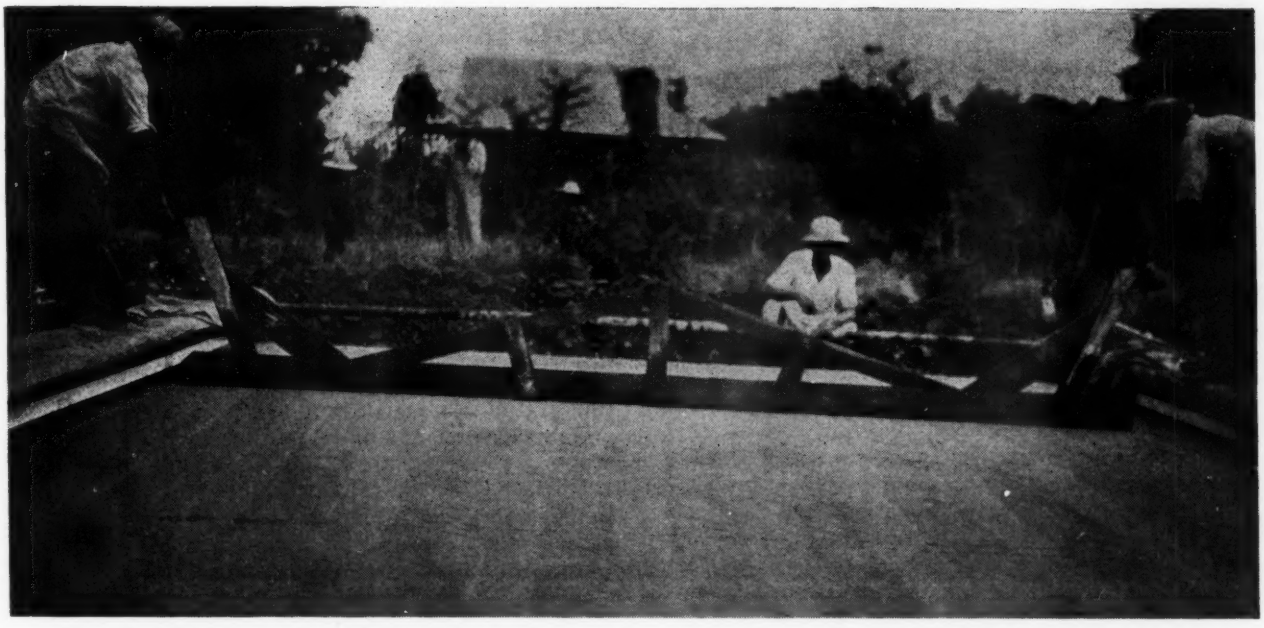
FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

PUBLIC WORKS Magazine • • JANUARY, 1940

Vol. 71. No. 1



Straightedging. Inspector (in white helmet) looks for uneven places as men on movable platform wield 14-foot straightedge.

# Modern Equipment and Scientific Control Speed Concrete Paving

## A description of up-to-date methods of constructing concrete highways, with special reference to construction of a 16-mile project in North Carolina by the Rea Construction Co.

By WILLIAM C. ANDERSON

TO LAY down a strip of concrete seven and one-half inches deep, 22 feet wide, and 16 miles long including driveways and intersections, all in the space of 100 days, requires more than just machinery and men. For such a building program it is necessary to have modern machines and men with experience and technical skill, but more than that it requires concentration moment by moment from every man on the job. This can only be the result of careful organization and close cooperation within that organization.

Proof that a project of this size can be completed in such a short time is the new leg of United States Highway 29 just opened between Charlotte, N. C., and Concord, N. C. This leg is the final link of a through-traffic highway which follows the old carriage road from Salisbury, N. C., to Charlotte. It completes the first step of a plan to construct a super (four-lane) highway connecting the richest industrial section of Piedmont, North Carolina. This 16-mile strip of pavement constituted the largest single paving project, according to contract estimate, ever undertaken by the North Carolina State Highway and Public Works Commission.

The purpose of this discussion is to show that "completion 30 per cent ahead of schedule" was not a result of breaks, flukes, or good weather (though the last was phenomenal), but was brought about by the use of sturdy, modern machinery kept constantly repaired, and by careful, economic organization of man-hours and machine-hours. Anyone can achieve similar results by placing the proper emphasis on the various phases of the work.

Laying a construction joint

The grading of this roadway was let under a separate contract, the major part of which was completed several months before paving operations began. For this reason all fills were allowed plenty of time to settle. The roadway was graded to one-tenth of a foot below proposed grade in cuts and to one-tenth above proposed grade in fills. Wherever possible, cuts and fills were laid back on a 4 : 1 slope. All boulders and loose rock were removed from the subgrade.

Naturally enough, the fact that the paving contract estimate was in excess of $357,000 was a spur to the efforts of every member of the Rea Construction Company organization. No one was forced to shoulder the blame for unavoidable breakdowns, but any foreman or operator guilty of neglecting his machine was considered a traitor by every other man on the job. Because of the fact that most of the foremen and operators were experienced men, such derelictions were few. The owner of the construction company was his own superintendent, carefully selected his personnel and labor, paid all of them well above average local wages, and had it understood by all his employees that he required constant application. The majority of them repeatedly stated to the writer that they considered themselves lucky to be in the employ of such a firm. Labor turnover was practically nonexistent.

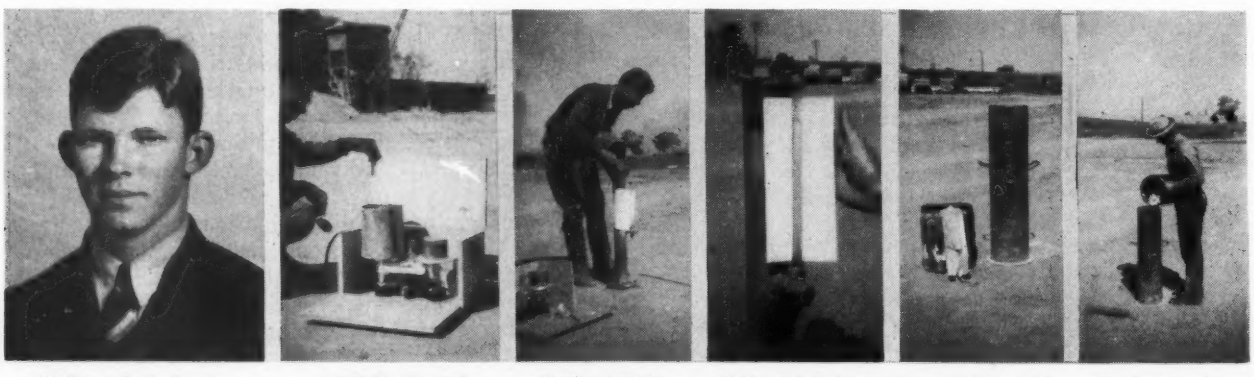
Speed, as is always the case in concrete construction, was of inestimable importance because rainy weather meant inevitable costly delay and a certain amount of rainfall had to be expected. Even so, there was no wasteful haste. When machines broke down, no time was wasted in crying or cursing but every other division of the work, particularly form-setting and grading, was prepared for the moment when operations would be resumed. Inspection throughout the 100 days of paving was carried forward in an attitude of vigilant helpfulness.

North Carolina highway specifications require paving contractors to keep at least 500 feet of forms and fine grade ahead of the paver, which requirement undoubtedly worked out to the advantage of Rea Construction Company on this job, as it should for all contractors. Although the amount of time required to place forms was greatly lessened by the use of a form grader, experienced personnel and experienced labor paid dividends in time here again. Actually, the forms (made by Blaw-Knox Co.) were kept nearly 1000 feet ahead of the mixer in order to facilitate use of a power-driven subgrader which rolled on the forms and which cut the subgrade to within one-quarter of an inch of proposed grade. Moistening and rolling of the fine grade together with the continued passage of batch trucks lowered it this remaining quarter of an inch so that there was comparatively a small amount of surplus dirt ahead of the drag template. This in turn eliminated repeated backing up of the mixer which would have caused a great loss of time.

The finishing was performed in the following manner:

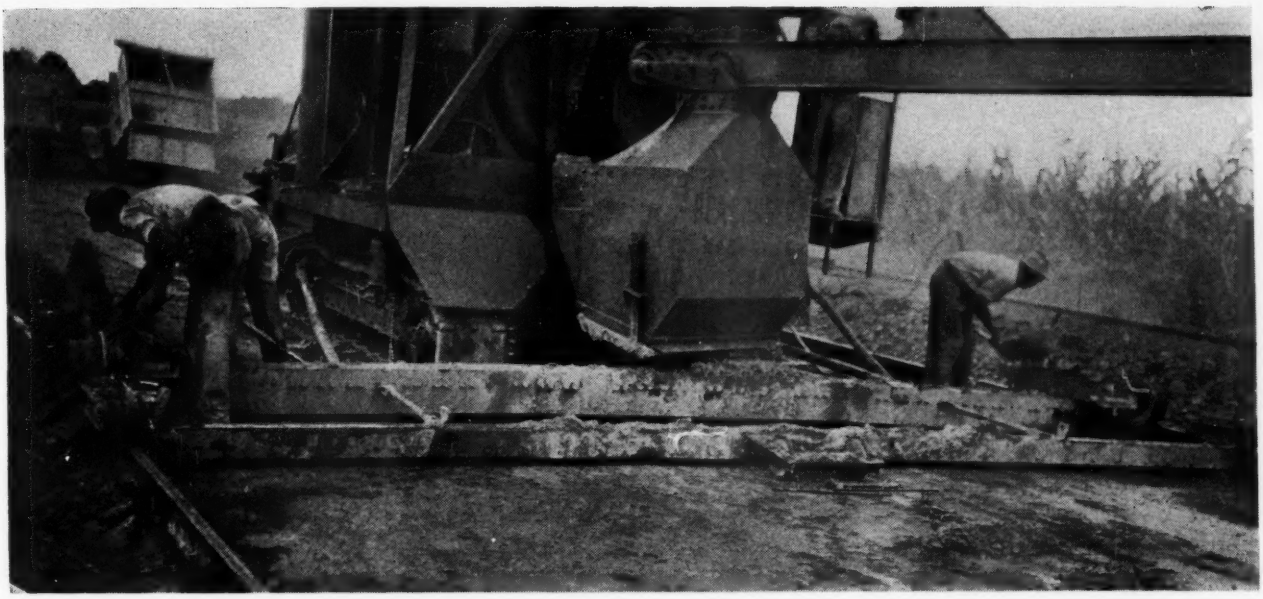
First, a Koehring lateral finisher gave the concrete initial shape, and to this finisher was attached the flexplane which automatically inserted the Flexible Road Joint Machine Company's longitudinal center joint. A Koehring longitudinal finisher followed these. The use of this type of finisher, one of the latest paving implements, affords a good example of the importance which the contractor attached to the use of up-to-date machines. As the float-carriage of this finisher is driven laterally across the strip of pavement, the float itself works back and forth parallel to the line of construction. Before this machine came into use, the same work was performed with clumsy hand-floats which necessitated a large amount of labor. Also, the old hand-finisher could not put crown in concrete without templates, whereas the motor-driven finisher can be regulated from flat surface to parabolic crown.

A belt finisher followed the longitudinal finisher, putting on a herring-bone riding surface. Intersections, driveways, and other parts of the concrete not covered by these machines were hand-floated. Transverse construction joints (Phillip Carey Co.) were placed in the ordinary way.



William C. Anderson, the author — Weighting the sand — Pouring sand into container — Water pushed to top of calibrated tube — Stone moisture container and measuring bucket — Pouring dry stone into container

Determining moisture content of sand and stone



**Drag template behind the mixer. The large board cuts the grade and the nearer one is the engineer's check board, with wheels to mark position for center joint dowel bars.**

Before the concrete had set up enough to support a man, it was straightedged so that any unevenness could be removed while it was still workable. This was performed from a platform of tube steel mounted on wheels and moving over the forms in the same manner as the finishing implements. The platform was large enough to allow two men to apply a 10-foot straightedge at any desired interval laterally or longitudinally.

Curing was completed with Sisalkraft waterproof curing paper, this being the first time that the North Carolina highway commission has allowed the extensive use of paper in curing pavement. The slab was completely covered, the paper overlapping the forms on both sides. When this method is used, the water which works out of the concrete cannot evaporate and therefore the concrete dries slowly enough to prevent checking and cracking.

But the part of this particular construction project where most organization was concentrated was the designing plant.

Since the usual type of concrete designing plant can be simply operated and since temporary delays there do not cause as much loss of time as temporary breakdowns at the paver, many superintendents are prone to leave this division of the job to inexperienced underlings. However, on this 16-mile project the designing plant was run at high pressure efficiency always. Operators of the batching bins, for example, were required to notify crane operators as soon as aggregates got below "see level" instead of waiting until bins were empty. Both cement and aggregates were shipped daily according to the following standing order:

3 cars of bulk cement, 300 barrels each.
7 cars of sand, 50 tons each.
15 cars of stone, 50 tons each.

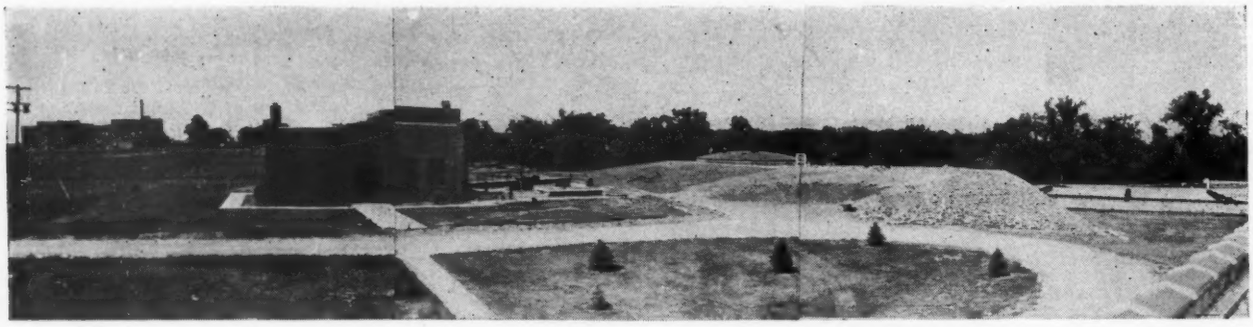
The bins were arranged in such a manner that all cement cars could be placed together and shifted to the cement hopper in a series with as little delay as possible. Sand and stone cars were alternated, two sand cars and four stone cars. Stone was shipped in hopper cars so that it could be dropped into a pit and handled with a clamshell. The crane that handled the aggregates throughout the job was a Northwest.

On this particular project, bulk cement was put into the hopper by hand labor, but on a subsequent job, another contractor used a bulldozer with scoop blades for this purpose.

The Rea company used a Butler cement batcher, which consists of a bin as wide as an ordinary freight car door and large enough to hold about 3500 pounds of bulk cement. From this bin a screw conveyor takes

*(Continued on page 39)*

**Small bulldozer for handling bulk cement. Used on a project connecting to the Charlotte-Concord pavement.**



Panorama of the sewage treatment plant, Grand Forks, N. D.

# Multiple Digestion of Sludge at Gr

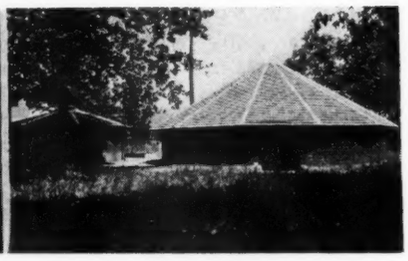
**Results of operation and brief description of Grand Forks' sewage treatment plant, which employs two-stage digestion.**

GRAND FORKS, N. D., a city of about 18,000 population, put into operation in February, 1937, a sewage treatment plant costing $100,854.73, of which $5,026.05 was for piping in the plant. At the same time they built five pumping stations costing $41,-365.89; also an intercepting sewer costing $117,324.88. The total cost of the work, which was built as a PWA project, was $290,517.77.

The plant was designed to treat a maximum of 3 mgd by sedimentation, aeration, chlorination of the clarified effluent, sludge digestion, and drying on sand beds. It includes two digestion tanks, two settling basins, an aeration mixing chamber, trash and grit-removing channels and a sludge drying bed. A 40 x 60 building covers one settling basin and the mixing chamber, and contains chemical storage room, chemical feed machine, pumps, main control valves, etc., and a combination laboratory and plant control room. The other settling basin is outside but adjacent to the building. Sludge pumps, air compressors, gas meter, furnace, toilet, etc., are in the basement under the laboratory. Most of the piping is laid in a gallery under the basement proper; but sludge transfer pipes, gas, hot water and power lines to the digester are laid in a tunnel connecting the main building with the pipe gallery between the digesters. (This tunnel was built in 1938.)

In order to bring the sewage to the plant it was necessary to build an intercepting sewer collecting the sewage from five large sewers which discharged into the Red River of the North. The fall from them to the plant is so slight that it is necessary to lift the sewage from each of these five sewers into the interceptor, the deepest pump installation being 39 ft. below ground level and the shallowest 23 ft. The sewage is screened at each of the pumping stations.

K. W. Riley



Sewage pumping station, intercepting sewer system

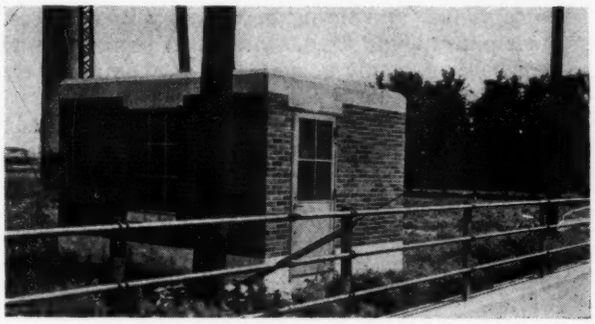
On reaching the plant, the sewage passes through a venturi meter; then through a bar screen into a grit chamber. From this it passes to a mixing chamber, in which chemicals (when used) are mixed with the sewage by means of compressed air introduced at the bottom through perforated pipes. Thence to sedimentation tanks or clarifiers 35 ft. in diameter and 9 ft. deep with Dorr equipment. A W&T chlorine machine is provided for treating the effluent.

The sludge is digested in two stages in tanks 40 ft. in diameter, the secondary tank being equipped with a Dorr gas dome. The primary tank is heated by means of a 6-turn pipe coil. In the secondary tank one heating coil is located in the narrow annular space between the concrete tank wall and the floating cover and several inches below the water surface to prevent freezing at this point.

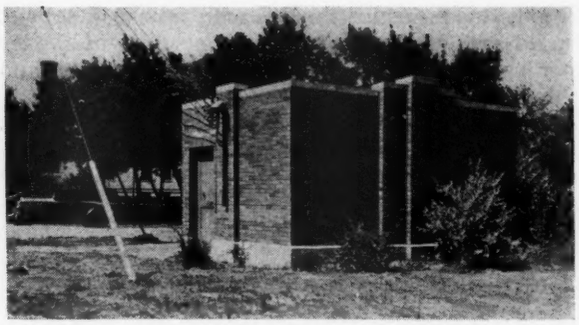
The collected gas is piped to the main building and the garage. In the latter it is burned in a small "Basmore" steam boiler for heating the building. In the main building, heat for it and for the digester are obtained by burning the gas in a 700,000 B.t.u. per hr. "Basmore" hot water boiler; centrifugal pumps circulating the heated water between the boiler and three radiators in the laboratory, two unit heaters with fans in the clarifier room, and the digester heating coils.

The amount of gas has been more than sufficient for

Underground lift station, intercepting sewer system



Washington Ave. underpass pumping station



Lift station No. 5, intercepting sewer system

# Grand Forks, North Dakota

By K. W. RILEY

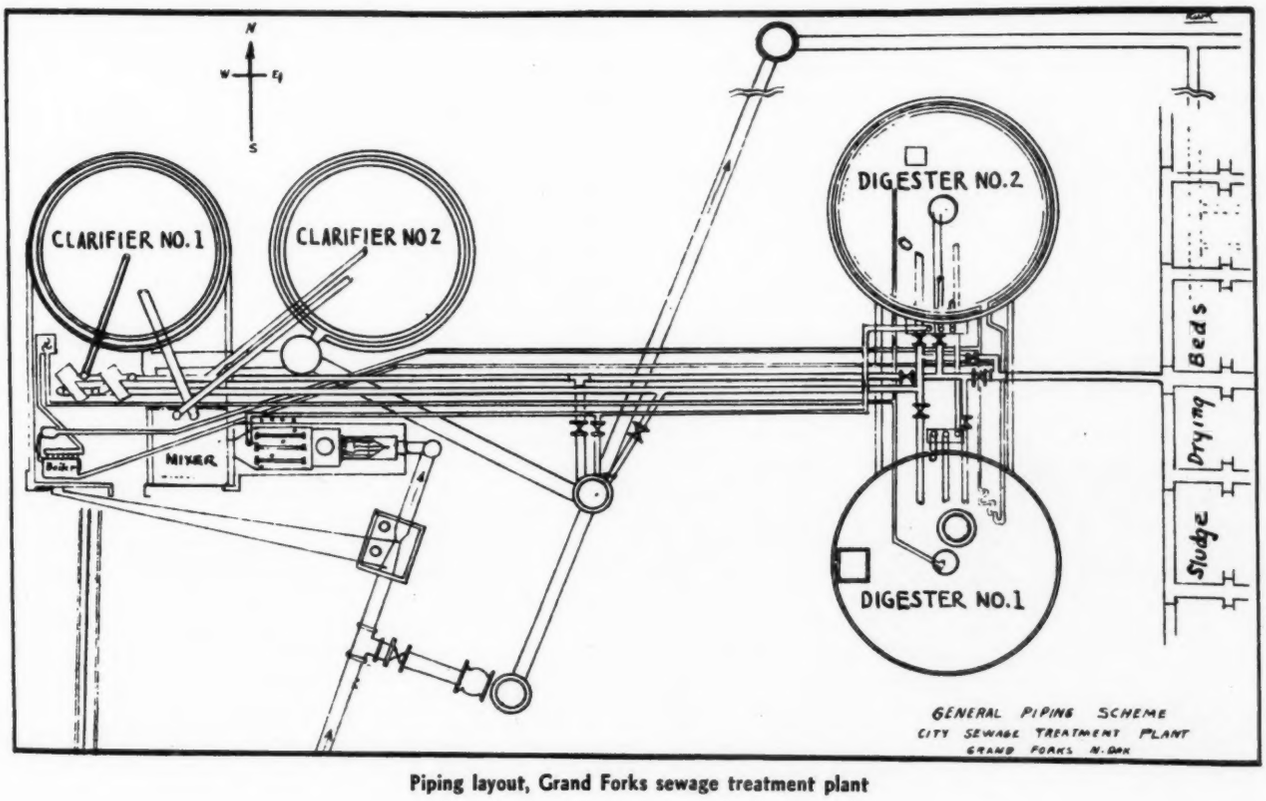
City Chemist, Grand Forks Sewage Treatment Plant

these purposes; how much more is not known, since it is known that all of it has not passed through the meter. Until the construction, in October 1938, of the tunnel between main building and digester gallery, there were leaks in the gas conducting lines and also in the floating cover. Thirty leaks, breaks, etc., have been repaired or plugged, and slight odors still noticed indicate that some leakage remains to be located. The measured gas since August 1937 has averaged 281,000 cu. ft. a month, or 0.52 cu. ft. per capita per day. Analyses of the gas have shown hydrogen sulphide always present, an average of 22.8% of $CO_2$ and an average of 550 B.t.u. per cu. ft.

The plant includes, in addition to the equipment already named, 2 Marlow sludge pumps; a 3½ lb. and a 7½ lb. air compressor; a Bailey integrating-recording sewage meter; a W&T dry feed machine; an American Meter Co. gas meter; a 1,000 lb. Energy Elevator Co. elevator; a Keystone automatic, gas-fired water heater; a gasoline engine-powered air blower; a gasoline lawn mower.

Of the five new pumping plants, three are housed in brick and tile buildings, two are under ground. Each contains a ventilating fan and motor, and a Pemberty sump pump; and in four of them there are 2 "Freflo" sewage pumps and three such pumps in the fifth.

The pumpage of sewage averages 46 gpd per capita; maximum day, 2,783,890 gal., minimum day, 25,-




Piping layout, Grand Forks sewage treatment plant

000 gal. It is estimated that the total volume of sewage pumped at the sewage plant represents 88% of all city water wasted to the sewers, or 62% of all pumped into the distribution system.

The total of all operating costs, except bond interest and sinking fund, has averaged $1,569.20 per month for the first sixteen months of operation; $63.16 per million gallons of sewage pumped. Up to date no chemicals have been used or purchased. Power for pumping has averaged $339.53 per month or $13.53 per million gallons.

The average reductions effected by the plant have been: Settleable solids, from 3.2% to 0.079%; turbidity, from 1700 ppm to 380 ppm; suspended solids, from 1670 ppm to 115 ppm; dissolved solids, from 1400 ppm to 1225 ppm; volatile solids, from 582 ppm to 194 ppm. The temperature of the sewage has averaged 63°; of the sludge, 76° in the primary digester and 64° in the secondary. The pH averaged 8.4 in the influent, 8.2 in the effluent, 7.7 in the primary digester. B.O.D., 585 in the influent, 292 in the effluent. Results expressed as percentages of reduction are: settleable solids, 98%; turbidity, 74.5%; volatile solids, 61%; total solids, 57%; chlorine demand, 35.2%; B.O.D., 45.6%. Changes in the sludge in the digestion tank have averaged as follows: Vehicle water, in sludge from primary digester, 75%; from secondary, 47%; total water, 92.6% and 86% respectively. Residual moisture in raw sludge, that from the primary tank and that from the secondary, respectively—4.7%, 4.5% and 3.7%; volatile matter, 44.4%, 42.9% and 40.6%; ash, 51%, 52.8%, 55%.

## Designing and Building a New Storm Sewer in Tunnel

CONSTRUCTION work is now under way on a storm sewer which the city of Rochester, N. Y., has long needed. This sewer serves some 1200 acres, of which about 882 acres are residential and about 326 are light industrial and commercial. In designing the sewer, the Kuichling formula, Q=CIA, was used. (Mr. Kuichling was at one time city engineer of Rochester). For computing runoff, the light industrial and "B" commercial areas were assumed to be 60% impervious, "B" residential areas 33.3% impervious and "C" residential areas 40% impervious. The value of intensity of rainfall was selected by a study of Rochester records as $I=12/t^{0.6}$, which experience has shown gives the intensity of rainfall that may be expected to occur once in five years.

The specifications for tunneling were patterned after those used on the Catskill aqueduct and the Wards Island sewer. Tomack Subsidiaries, Inc., Rochester, were the low bidders. Construction started Nov. 7, 1938, and work is expected to be completed about April 1, 1940. Drilling of the tunnel was from intermediate shafts. Ingersoll-Rand drifters of the wet type were used, thus preventing dust; mucking was done with an Eimco mucking machine; electric locomotives were used for removing muck. Ventilation was provided by two Ingersoll-Rand 2400-cfm. exhaust fans through corrugated metal pipe.

On one section, the contractor elected to cut a horizontal drift from Deep Hollow Ravine to the line of the tunnel, working thence both north and south, rather than to sink a vertical shaft. This excavation was in soft ground, and lining of the tunnel was necessary, liner plates being used. On another section where the rock cover was only about 8 feet, the contractor elected to use open cut methods.

Lining for the tunnel sections is being placed with a Rex Pumpcrete located on the surface of the ground and delivering concrete through a 6-inch pipe up to 600 feet. Where the shafts are a considerable distance apart, well holes have been drilled to the tunnel between them, a pipe inserted, and the concrete delivered by the Pumpcrete through these well holes, which are generally placed about 1,000 feet apart. These well holes are also useful at times in carrying compressed air pipes.

The work is being carried on under the direction of Henry L. Howe, city engineer; Kenneth J. Knapp is supervising engineer; and H. Remington Kohler is field engineer. The information in this article is abstracted from a paper by Mr. Knapp before the Rochester Engineering Society. PWA on this project has been represented by Alex Thomson, resident engineer; and Harry Barnes and Murray A. Bruchman, engineer inspectors. David Ripton is superintendent.

## Evaporation at Charleston, S. C.

The water department of Charleston, S. C., has kept a record of evaporation from the water surface of its Goose Creek storage basin and from the land near by for a period of 34 years—believed by J. E. Gibson, manager and engineer, to be the longest continuous record by any water supply.

This record shows the average annual evaporation from water to be 48.35 in. and from land 81.08 in. The maximum annual from water was 65.57 in. and the minimum 34.23 in. From land the maximum was 110.63 in. and the minimum 59.03 in. The ratio between water and land evaporations varies from year to year; from a maximum of 2.19 (34.23 in. and 74.98 in.) to a minimum of 1.39 (61.37 in. and 85.14 in.).

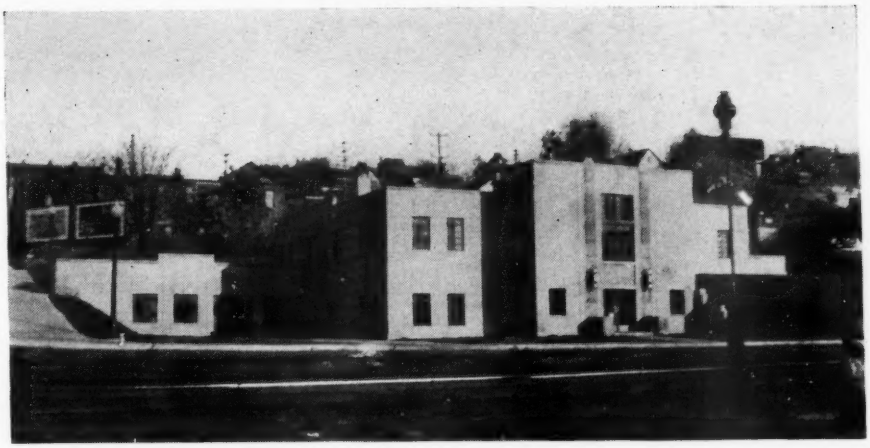
The monthly averages of evaporation from water and land for the 34 year period are given in the table.

The method of obtaining the evaporation from the water surface is described briefly by Mr. Gibson as follows: "A vessel, approximately six inches in diameter, is suspended in a second vessel about two feet in diameter, and immersed and floated in the storage reservoir off shore, so that it is subjected to the wind action and also to the temperature of the water in the basin. This gauge or tank is fitted with a hook gauge and every 24 hours an operator measures the quantity of water required to replace the water that has evaporated from the inner vessel; the quantity of water in cubic centimeters required to replenish the vessel indicates the number of inches of evaporation.

"A similar gauge is located on shore where it receives the wind and sunlight, and is buried in a large fitting filled with earth so as to approximate the ground temperature. This gauge, however, is covered by a large glass frame so as to protect it from any rainfall that might occur, and here again the quantity of evaporation is measured by the quantity of water required to replenish the gauge.

"Record of the reservoir gauge during rainfall is vitiated to a certain extent and at times, due to meddlesome parties, the record on the land gauge is also destroyed."

| | *Jan.* | *Feb.* | *Mar.* | *Apr.* | *May* | *June* | *July* | *Aug.* | *Sept.* | *Oct.* | *Nov.* | *Dec.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | 2.32 | 2.62 | 3.91 | 4.84 | 5.59 | 5.49 | 5.27 | 4.93 | 4.35 | 4.01 | 2.80 | 2.22 |
| Land | 4.21 | 4.71 | 6.95 | 8.06 | 9.37 | 9.29 | 8.71 | 8.22 | 6.96 | 6.08 | 4.63 | 3.89 |



Buildings housing pumping and purification plants

# We Built a Modern Water Works Plant in Keokuk

By WALTER L. GARRISON

Superintendent, Keokuk Municipal Water Works

ON June 1, 1938, Keokuk, Iowa, purchased from a private company the entire waterworks property then furnishing the municipal supply, which included an old steam-operated pumping and filter plant built in 1878, the distribution system, meters, and all other equipment. For making this purchase, bonds were issued in the amount of $550,000, to be paid solely out of the earnings of the water works; in addition to which a government grant of $157,000 was obtained. Construction of an entirely new electrically operated pumping station and filter plant was begun at once.

The present population of the city is about 16,000, the larger part of which is served by this plant. The average daily consumption ranges from slightly over one million gallons in cold weather to one and a half million in warm weather. We are at present about 98% metered. The new plant was designed to furnish three million gallons a day—about double the capacity of the old plant.

The new pumping plant, located about two hundred yards south of the old plant, consists of three electrically driven pumps, two with a capacity of 3 mgd and one of 1½ mgd, furnished by the Allis-Chalmers Co.

The raw water is taken from the Mississippi river at a point above the Keokuk and Hamilton dam and flows through a 24" intake pipe to settling basins; this flow being by gravity except at times of low stage of the river, when the low-service pumps on this line can be started up.

To equalize the pressure on the distribution system and provide better protection, a new elevated storage tank was erected on one of the highest points in the city, about two miles from the pumping station. The bottom of the tank, which holds one million gallons, is 100 ft. above the ground. This was built and erected by the Pittsburgh-Des Moines Steel Co.

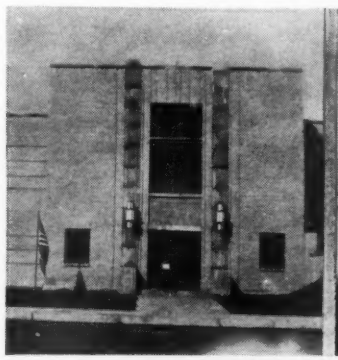
During the past year we have added to the distribution system ten miles of cast iron pipe ranging in size from 6" to 16", giving us at this time a total of 37 miles of cast iron and 5 miles of steel pipe. Also 90 fire hydrants were set, bringing the total up to 281.

Treatment includes softening and recarbonating, filtering, and treatment with activated carbon. The total detention period of the water in its course through the treatment plant is four hours.

The settling basin has a capacity of 500,000 gals. It is of concrete and is divided into two halves, each of which is further divided into two sections which provides a first and second recarbonization chamber. It is covered, and the sides are banked with earth and this and the top are sodded. The sludge is removed by Chain Belt "Rex" collectors to an end sump, from which it is conducted by a drain to the river about a half mile below the intake.

The chemicals used in connection with the treatment are alum, iron sulphate, activated carbon, lime and ammonia sulphate. The water is softened by the use of lime and recarbonated with $CO_2$ which is obtained from the Kewanee boiler plant used for heating the building. The chemicals are all applied in the quick mix basin. The feed machines were all furnished by International Filter Co.

The sand filters are of the open type, made of concrete as a part of the building; four beds in all, with a design capacity of 2 gal. per square foot per minute. The filter controls were furnished by International Filter Co. and the hydraulic valves by the Iowa Valve Co. The filters are washed by means of a washwater pump with 16" discharge at the rate of 7,500 gpm, drawing water from the clear well, which underlies the plant and has a capacity of 157,000 gallons.



Front of water works building

One million gallon tank

Alan N. Buck

# 12.18c Per Sq. Yard Builds Year

**Details of construction methods used by a Kansas county, with material analyses, equipment and cost data. Results include low maintenance costs and excellent service.**

MACON COUNTY, Illinois, is located in almost the center of the State in the heart of the rich agriculture section. While the soil is ideal for agricultural purposes, one can realize readily that it is not the best for highway purposes. Our county is fortunate, however, in having the Sangamon river, a tributary to the Illinois and Mississippi rivers, flowing diagonally through the county, resulting in many deposits of glacial gravel.

There are approximately 1,000 miles of public roads in the county. The State Highway Department has built and maintains the 175 miles of Federal and State roads. The county system comprises 275 miles.

Windrows after mixing with S C 3

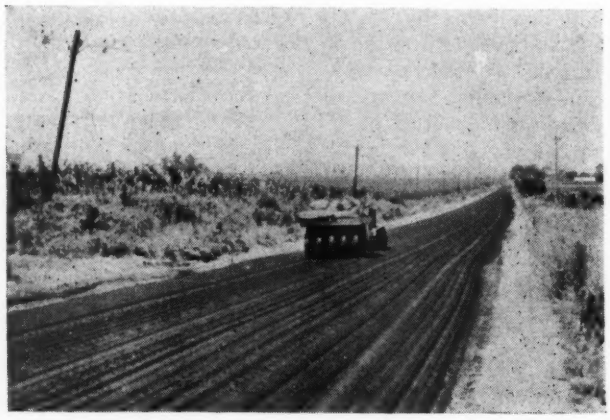
The balance of the roads are under the jurisdiction of the townships (of which there are seventeen in Macon county), giving each township an average of 32 miles of road.

The State highways in this county have been designed and located very advantageously, providing for 8 radial routes from the City of Decatur, which is in the geographical center of the county. In the development of its system, the County Highway Department has succeeded in providing two complete belt line systems intersecting these radial roads at various distances from the City of Decatur. The county has also taken over from the townships, for construction and maintenance, other highways, such as boundary routes between townships and routes between the larger villages in the county.

In determining the program for any year, three factors are taken into consideration: 1. The results of the State Planning Survey showing traffic quantities. 2. The order in which the various county roads have been improved with drainage structures and grading. 3. The order in which the county system has been surfaced with local gravel or other metal surface.

At the end of the construction season of 1938, all the county system had been provided with a metal surface. However, before this type of surfacing had been completed on the county system there was much demand for a dustless, smooth type of surface, caused by the tremendous increase in the number of motor vehicles operated on the public highways, and as a result we had already completed some bituminous surfacing of existing gravel or stone roads prior to this date.

Our 1939 program anticipated about 20 miles of additional bituminous surfaces, the types of surfaces selected depending upon the amount of use various sections received. For instance, in the neighborhood of the lake, which is in the center of the county and which adjoins the City of Decatur, we provided a high type bituminous surface. We expect to build each year two or three miles of Lake Shore Drive, so that eventually the 40-mile loop around the lake will be completely paved. Each year we also construct bituminous surfaces on our county belt line roads, which are financed by Motor Fuel Tax refunds and upon which the State Highway Department has jurisdiction as to standards of design and construction.



Rolling with pneumatic tired roller and 2-ton Cat.

# 'Round Dustless Roads

By ALAN N. BUCK
County Superintendent of Highways,
Macon County, Illinois

Surface before shoulders had been constructed

Applying sand to seal coat

However, in the carrying out of this program, we cannot overlook the purely local roads, which do not carry as much traffic and upon which there are not as many towns. It is a road of this latter type which I will briefly describe.

We selected a section 2¾ miles long, connecting a county belt line road with a State paved road, and made an analysis of the gravel on the road. This road had been surfaced as a traffic-bound gravel section, but was very dusty during our long and very dry summers and required much maintenance to provide a smooth riding surface. The analysis of the existing gravel road was as follows:

| | |
|---|---|
| Passing 1 inch sieve | 100% |
| Passing ½ inch sieve | 90% to 94% |
| Passing Number 4 sieve | 67% to 80% |
| Passing Number 8 sieve | 50% to 62% |
| Passing Number 16 sieve | 37% to 49% |
| Clay and Silt | 9% to 14% |

We added 4½ cubic feet per lineal foot of gravel to this surface, which provided a 3-inch thickness, 18 feet wide. The gravel added to the existing material on the road met the following specifications:

| | |
|---|---|
| Passing 1 inch sieve | 95% to 100% |
| Passing ½ inch sieve | 65% to 85% |
| Passing Number 4 sieve | 45% to 65% |
| Passing Number 8 sieve | 25% to 40% |
| Passing Number 16 sieve | 15% to 30% |
| Silt | 8% to 15% |

These specifications correspond to our pit-run gravel, so that no loss is incurred in providing this material. This material was windrowed onto the highway surface in two equal windrows and the existing base was thoroughly bladed and the cross section repaired to fit our standard.

After the base had been prepared, water was added, using a sprinkling wagon, and the road was bladed with a motor patrol and rolled with a rubber-tired roller so that a smooth uniform surface conforming with the standard cross section was obtained. Also, all loose material was compacted into the base.

After the base had been prepared, a prime coat of between ¼ and ½ gallon of SC-3 per square yard was applied 19 feet wide. Immediately following the application of the prime coat, enough loose material was bladed onto it from the windrows so that traffic could immediately be let on the road without picking up the bituminous material.

After 48 hours had elapsed, the gravel in the windrows was spread over the road to a thickness of 3 inches and SC-3 was applied in two applications each 9 feet wide and at the rate of 0.8 to 1.05 gallons per square yard.

Immediately behind the bituminous distributor followed the road disc hauled by a two-ton caterpillar tractor. This disc action is very advantageous in giving the road oil and aggregate a preliminary manipulation. After one-half of the aggregate had been treated as described, the remaining half was bladed onto the already disked material and treated in the same manner.

The mixing operation then followed. For this we used an Adams No. 3 re-tread paver hauled by a Caterpillar D-8 tractor and the mixing was continued with with the mixing-in-place outfit as above described by moving a windrow from one side of the primed surface to the other until the material was homogeneous in color.

Immediately following the mixing, the windrows were laid down with the same retread paver and cat in two 9-foot strips. Much care had to be given to the joining of the two strips in the center of the road in order that a uniform cross section be obtained. Immediately following the laying of the material, it was rolled with a pneumatic tired roller hauled by a two-ton Caterpillar tractor. The rolling was started on the outside edge of the pavement and proceeded toward the other edge overlapping on successive trips. We find it is necessary to roll 4 or 5 times and at no time do we close the road to traffic. On the final rolling, the roller is hauled by a truck. We have also found that when this

work is done in hot weather there is considerable rutting of the surface by steel-tired traffic using the pavement, and we have had to maintain these with a rubber-tired roller, in some instances as much as 30 days following the final construction operations. During this period, the slow-curing cut-back asphalt sets up and with the advent of colder weather the pavement assumes a more stable condition.

The cost of the section was as follows:

Equipment Cost; which includes motor patrol for shaping, preparing the base; 2-ton and D-8 tractors, disc, retread paver, pneumatic tired roller and trucks used for hauling gravel to the road. . . . $1,180.62 or $.045 per square yard.

Labor Cost; which includes all machine operators, truck drivers, common labor and WPA labor which we charged to this job. . . . . $177.50 or $0.007 per square yard.

Material Cost; which includes the gravel at the source and the SC-3 spread on the road. . . . $1,871.58 or $.0698 per square yard.

The total cost of this job, therefore, is $0.1218 per square yard.

It has been our experience in the past that, after a year or two of service of a pavement of this type, it is advisable to give it a seal coat treatment of .10 to .15 gallon per square yard of MC-3 and enough torpedo sand to prevent picking up. This costs approximately $0.03 per square yard.

Immediately following the completion of this type of surface, we have rebuilt all the shoulders and ditches with WPA labor. The cost of this work is not figured into the above but we find this is an ideal type of work for the WPA. The ditches are staked to cross section and grade and the excavated material is used to construct shoulders necessary to the additional pavement thickness.

One of the advantages of this type of road is the low maintenance cost. If for any reason a section of this road fails (excepting spot failures) it is an easy matter to scarify and add more gravel or cut-back, whichever is necessary, and to re-lay in the same way as in construction. Spot maintenance is carried out by the regular maintenance crews and the same procedure is followed as for any general bituminous maintenance.

It can be seen from the above statement of costs, etc., that a road of this type is economically possible for locations that do not warrant a higher expenditure. This surface provides smooth, dustless, year-around travel and we consider it a step in the stage development of a system of county highways.

## Technical Specification for Eearthworks for German Motor Roads

Before the design of any earthwork, soil surveys, including borings, are to be made, and samples submitted to laboratory tests. Soils are classified as follows:—(a) top soil, (b) non-cohesive soil, (c) cohesive soil, (d) stone, (e) waterlogged soil (peat, ooze, etc.). The different types of soil are to be removed separately and drainage facilities must be provided. The material used in the construction of embankments is to be placed in successive layers, the soil being tipped from above and then distributed to the correct level. A portable apparatus for measuring the height of each layer as constructed is prescribed. Consolidation is to be effected by mechanical means. Tamping machines are recommended, the weight of the machine depending on the gauge of the rails used for the transport of material. Lighter models are to be used on the shoulders, which should be consolidated first, from the edges towards the centre of the embankment. If any spreading occurs at the foot the extruded material can be used in finishing at the toe of the embankment. Irregularities in the upper surface of the embankment are to be eliminated by light rolling. The soil constituting the foundation of low embankments should be homogeneous, intrusive deposits being removed and replaced by appropriate material. No settlement should take place on such a foundation provided that the embankment is well consolidated. On weak foundations the amount of settlement to be expected can be calculated.

A layer of peat up to 13 ft. can be removed and replaced by sand. If the water content of the peat is not too high, drainage channels can be cut in the subsoil and filled with subsoil material. It has been found that if the height of the embankment is considerable and thorough consolidation is effected by machinery, very little settlement will take place after construction is finished. Where excessive peat is encountered it can be removed by blasting and replaced by stable material. Special attention is paid to the uses of fertile top soil for encouraging natural growth on slopes, and existing vegetation should be carefully protected. Where the formation consists of stone, care must be taken that it is smooth and that all projecting material is removed. Cracks must be filled with non-capillary soil. Where too much rock has been blasted the formation should be levelled by applications of lean concrete. Embankments of hard rock must be constructed in successive courses. Soft rock should be consolidated with heavy tamping machinery. Where other types of soil are placed on a foundation of stone an intermediate filter course must be provided. Special care should be exercised in the selection of the soil used in back-filling engineering structures and consolidation should be effected by tamping units up to 500 kg. Hand tamping is not permitted. A suitable drainage system must be provided. Drainage channels must not be laid under the road bed itself and any ditches necessary to effect drainage during construction must be subsequently filled. Stone-filled drains must be provided with a filter course in order to prevent the entry of embankment material. The responsibilities of the contractor are enumerated in the concluding portion of the article. C. SCHNELL and K.-H. HARTMANN: *Strasse,* 1938, 5 (18), 566-9 and 572-4. *Road Abstracts.*

## Calcium Chloride Specifications for Concrete Curing

Revisions of specifications for curing concrete with calcium chloride as dry admixture for high early strength and cold weather concreting and as surface treatment for pavement curing, have recently been adopted as standards by the American Society for Testing Materials.

The new specifications (A. S. T. M. designation C82-38) cover the use of dry flake calcium chloride, as well as the solution form previously prescribed, by simply adding 1 to 2 lbs. of calcium chloride per bag of cement used, placed in the skip with the aggregates, before mixing. This will unquestionably prove of most practical advantage in concreting when special provision must be made for high early strength and cold weather construction.

Specifications for surface curing of pavements (A. S. T. M. designation C82-38) allow the use of 1½ instead of 2 lbs. of calcium chloride per square yard, to be spread over the surface following a minimum of 12 hours of wetted burlap and sprinkling.

# The Editor's Page

## How Well Do Technical Societies Serve the Engineer?

Of late there seems to be a wave of questioning among engineers as to whether or not the average technical society fails to serve adequately the average engineer. In every organization of this type, the members range from tyro to expert. How to serve them all best is a problem—and who should realize this better, or approach the subject more humbly, than the editor of a technical magazine, who is confronted with the same problem? (PUBLIC WORKS has published many complete "instruction" articles for these men.)

An eastern engineering society delved into this question and asked their members to state their feelings. The weight of the opinion of those replying seemed to be that the average technical society favors the more advanced members of the profession, and that the groups lower in the scale do not receive the consideration they deserve.

There is not much glory in writing an elementary text; to do that, one must have a thorough knowledge of the subject, and his equals in the field regard the author with a kind of pitying condescension. It should, however, be more than adequate compensation to know that the information given has helped young men to progress, or older men to advance after a hard fight upward against the handicap of inadequate preparation.

Aside from doing the work they have to do, engineers have an obligation not only to continue the development of the science of engineering, but also to give adequate thought to the twin problem of training the young men and helping those inadequately prepared, so that they may become competent to succeed them.

## "Blackouts" and Traffic Accidents

Nothing better illustrates the vital role that highway illumination plays in safer highways than the greatly increased toll of accidents that are reported to us from cities "blacked out" in the war areas as a protection against air raids.

Analyses of these accidents ought to help highway and safety engineers to determine in what respects our streets and highways can be better designed and equipped, so that even inadequate lighting conditions will not bring on too many accidents. White or light-colored curbs; well-placed and visible highway warning signs, as for cross streets and intersections; divided highways; underpasses for pedestrians; and sidewalks in many more areas than now have them, are among the improvements indicated.

Better standards should be set up for determining where sidewalks and other pedestrian safeguards are needed. No one, probably, thinks that rural sidewalks should be built along every mile of highway, but in many well-populated rural areas they are needed—blackouts or no blackouts. This magazine, believing that the lack of sidewalks is one of the glaring inadequacies of our present road systems, has published a number of articles on rural sidewalk construction. It invites more.

Good highway illumination is needed, but illumination should not be obliged to carry the burden of deficiencies in other phases of engineering. While illumination of roads is permitted in this country and becoming general, we should design roads not only to be safer and better with it, but also to perform adequately without it.

## Accident Prevention: A Good Time to Consider It

Cold weather usually tends to increase the number of construction accidents. Men are bundled up in heavy clothes and are more clumsy; heavy objects slip easily from numbed fingers; ice and snow cause accidents through slips and falls; a man concentrates on keeping warm and does not see hazards; there is even danger in heating apparatus.

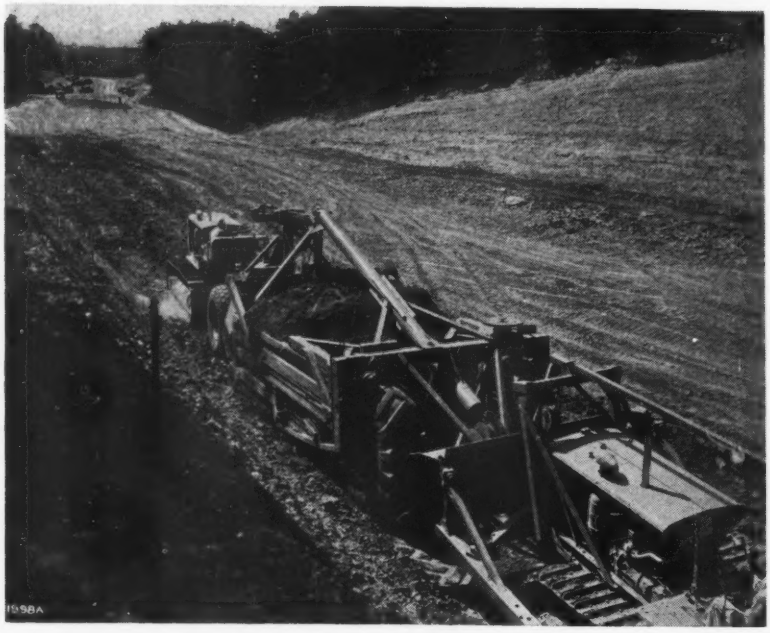
Plans should be considered now to reduce the chances that these cold winter accidents will happen. Training in what *not* to do, organization to provide for the enforcement of good practices and safe construction methods, and where possible an arrangement of the work so that the jobs made more hazardous by bad weather conditions will be scheduled for good weather.

Accident prevention should go a lot farther than construction jobs. The sewage plant requires attention; repairs and replacement of water pipes is a fruitful source of cold weather accidents. And perhaps most important of all is prevention of highway and pedestrian accidents. Snow removal, treatment of icy areas and prompt plowing of sidewalks so that pedestrians, especially school children, will not have to walk in the street are all important matters.

No one knows how much accidents cost, but they total a tremendous amount. The Associated General Contractors estimate that construction accidents could be reduced one-half, with care and training in safety, and that the saving from this reduction in preventable accidents would amount to about $200,000,000 per year.

## Stream Pollution Eradication

Most everyone interested in the matter of control of stream pollution is concerned or dissatisfied with the slow progress that is being made toward any real solution of the problem. Some of the bills that have been before Congress have not provided means for enforcement; others have lacked support because some groups have favored vesting the necessary power in the Public Health Service, while others have preferred the Army Engineers. With Congress again in session, it is time that these differences be composed and that everyone recognizing the need for eliminating stream pollution, whether for public health or public wealth, work together for a sound program beginning at the earliest possible time.

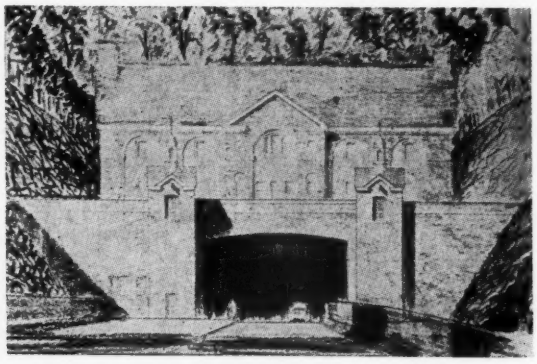


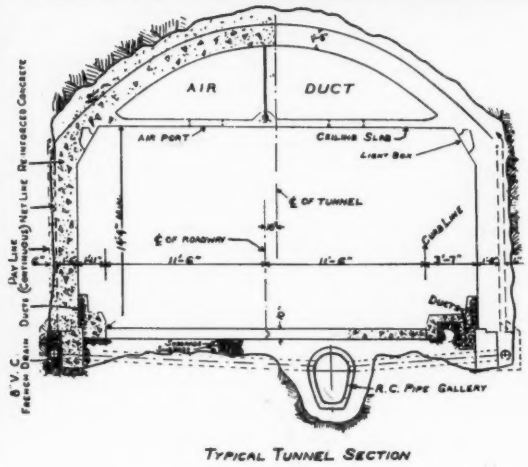
# Pennsylvania's New Turnpike In Pictures

THE Pennsylvania Turnpike is the greatest single highway project ever attempted in the history of the United States. As such it is of peculiar interest to all engineers. Even more important for future highway work is the fact that it is a proving ground for new equipment and new methods. Highways of today must be straight, wide and safe. To accomplish these objectives may require a great deal of earth-moving.

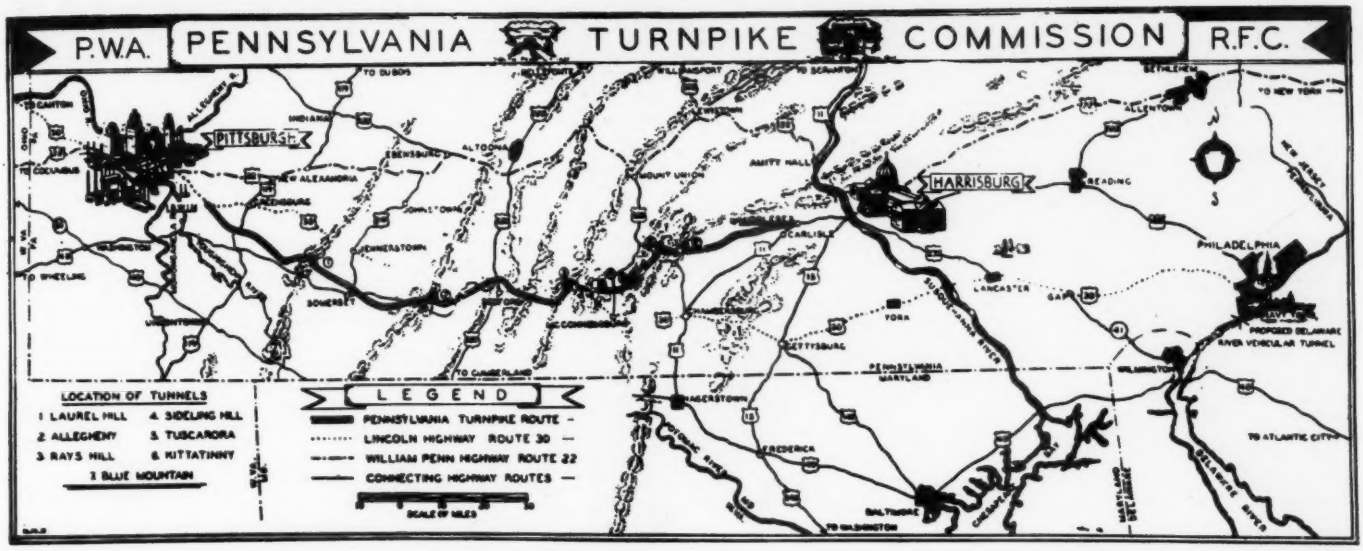
Speed and economy are equally necessary in performing such a gigantic work. On these pages are given a few illustrations of the modern, speedy and economical equipment that is being used on this unusual and interesting project. Work began Oct. 27, 1938, and the project is scheduled for completion this coming spring.

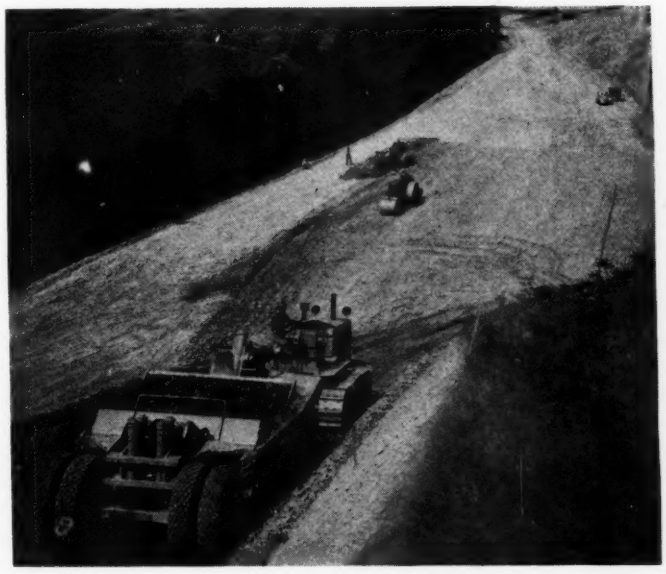
**Left, top and bottom pictures are Cleveland tractors and Heil 12-yd. self-loading scrapers on the Connell and Laub, McKinley and Jacobson Contract (No. 4). The center picture shows a LeTourneau unit at work with a Caterpillar tractor fore and aft. Below is architect's sketch of tunnel portal and a typical tunnel section with dimensions.**

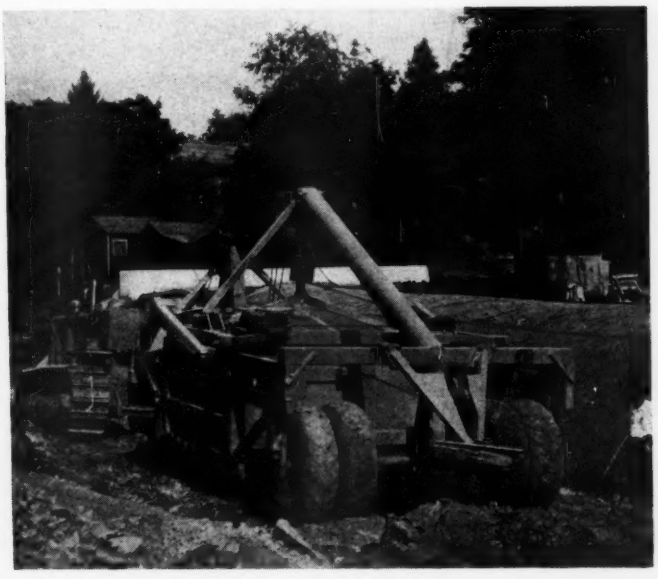


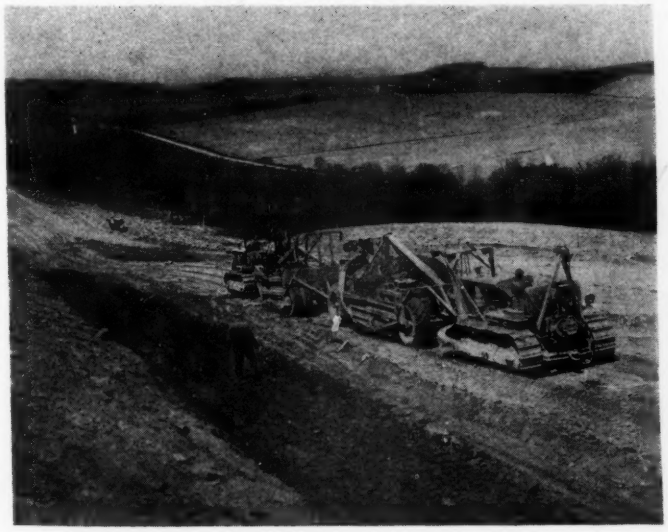



TYPICAL TUNNEL SECTION

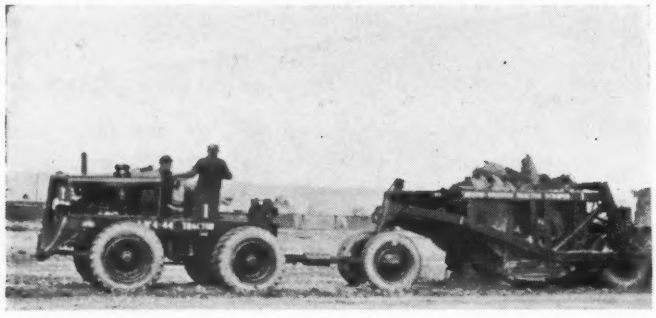


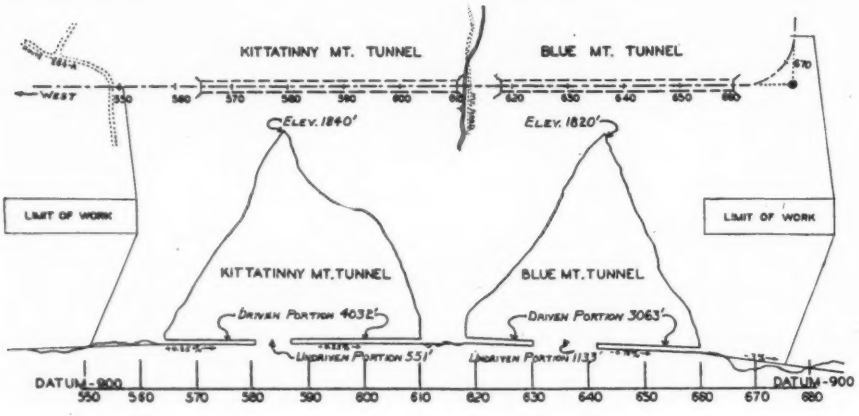





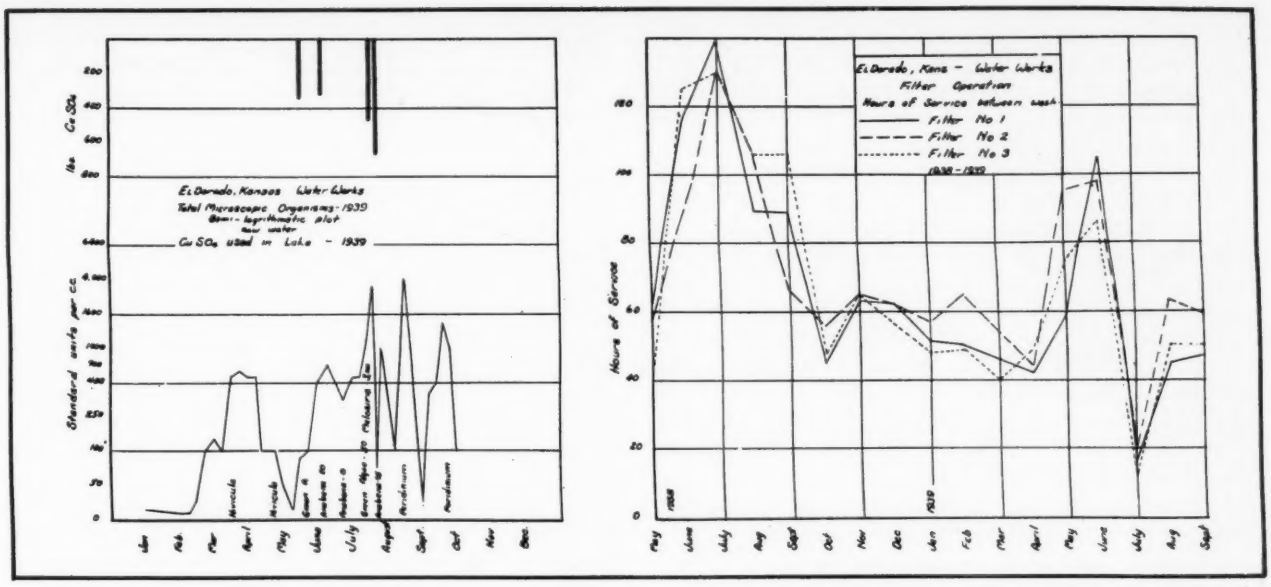


**At the top is the map of the Pennsylvania Turnpike Route. Photos—left above, Cletrac and Heil combination; left below, LeTourneau and Caterpillar; right above, a LeTourneau aside a big culvert; right below, a Cletrac and Gar Wood trailbuilder.**






**The halftones on this page show Austin-Western equipment at work on the Turnpike. At the top is the new 444 rubber-tired tractor with scraper units; below a head-on view of the same units; the two bottom cuts are still other views of the equipment at work. The drawing at the bottom shows how tunnels cut the grade and the driven portions of the tunnels.**




Microscopic organisms in lake water

Hours of operation, by months, of each of the three filters

# Successful Taste and Odor Control in El Dorado, Kans.

By A. E. FRENCH
Superintendent of Water Plant, El Dorado

LAKE EL DORADO has an area of three hundred sixty acres, one billion gallons capacity, three intake drafts which permit water to be drawn at a depth of 11 feet, 21 feet, or 31 feet below the crest of the spillway.

The purification plant consists of aerators, mixing flume, primary mixing basin with mechanical agitation, small settling basin with continuous sludge removal equipment, large settling basins, final mixing basin, final settling basin, and rapid sand filters with 2,500,000 gallons per day capacity. The water is prechlorinated, post chlorinated, softened and recarbonated.

The first requirement of drinking water is that it be free from pathogenic bacteria, but to be accepted by the consumers it must also be palatable, free from taste and odors. Our raw water usually contains large numbers of microscopic organisms. Odors due to the presence of these living organisms are common and sometimes very offensive. It has been only within recent years that these odors have been understood. At one time it was supposed that it was only by decay that these microorganisms presented a taste and odor problem. It is now well established that many microorganisms in their natural and living form have an odor which is peculiar to them just as larger plants and animals with which we are more familiar have their own natural and peculiar odor.

Building housing El Dorado water works

The first attempt to remove taste and odor from our water other than to merely remove the organic matter was made by adding activated carbon to the raw water and also to the settled water. Any carbon not removed by settling was removed by filtration along with some absorbed tastes and odors. In February 1938 one hundred fifty pounds of carbon per million gallons failed to remove all the fishy taste caused by two million standard units per liter of synedra. In August 1938 one million standard units of Anabaena was accompanied by a grassy taste in the water. This taste was checked with carbon and the lake was treated with one pound per million gallons of copper sulfate. The Anabaena immediately disappeared as well as the taste and odor. In September anabaena began increasing but was destroyed in the same manner before any taste was detected in the treated water. In March and April 1939 Navicula reached a maximum of 500,000 s.u. per liter but caused no trouble. In the spring and summer we had no rain (which usually flushes the lake and retards the growth of algae for a few weeks) sufficient to increase the turbidity of the water. When the water reached a temperature of 65° F anabaena again appeared, first in the form of flos-aquae, a week later the circinalis form appeared. These forms had appeared in the same

order the previous summer, but in June that time instead of September. Along with anabaena an increasing number of melosira was detected. Eight tenths of a pound per million gallons of copper sulphate applied to the lake destroyed the anabaena but had little effect upon the melosira. This diatom caused very little trouble in quantities less than 2,000,000 s.u. per liter, but this number was exceeded in July, at which time we experienced a ninety per cent reduction in hours of filter runs between washings. An examination of the filter influent revealed 500,000 s.u. per liter of melosira in spite of the coagulation, sedimentation, and superchlorination to the extent of one part per million of chlorine added to the raw water. By using an excess of coagulant, this number was reduced to 100,000 s.u. per liter, but the filter runs were not greatly increased until the melosira were destroyed in the reservoir by 1.2 pounds per million gallons of copper sulfate.

After repeated applications of copper sulfate the appearance of a microorganism more resistant to this treatment can be expected. Therefore we were not greatly surprisd upon the arrival of large numbers of peridinium. In quantities of 1,000,000 s.u. per liter this protozoa caused no odor. Following a strong wind this number rapidly decreased but within a few days after the wind subsided the water contained 4,000,000 s.u. of peridinium per liter, which imparted to the water a distinct clam shell odor. Microscopic examination of samples taken at the water levels of the three intake drafts furnished valuable information. The samples at the center and lower drafts contained only 40 per cent as many peridinium as the upper draft which was open. Shifting the draft simplified our problem for the time being, but the peridinium continued to increase until 3,000,000 s.u. per liter existed in the water entering the center draft. Fortunately for us this last protozoan threat to the palatability of our water was short lived. The disappearance of the peridinium was preceded by another strong wind which may or may not have been the cause. Other microscopic organisms which have been found, usually in small numbers, but have caused no trouble include: staurastrum, pediastrum, closterium, cosmarium, ceratium, anuraea, notholca bosmina, cyclops, and daphnia.

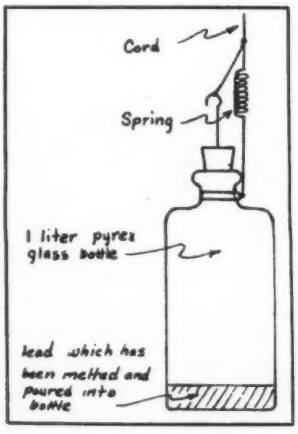
It is essential that all basins be free from bottom sediment. Taste imparted to water from this source may be offset by carbon fed into the raw water and thus the taste of the water improved as it passes through the plant, but the same improvement may be accomplished with less chemicals if the basins are clean.

The quantity of copper sulfate used depends upon the temperature and quantity of water to be treated and the specie of the undesirable microorganism. This quantity is limited by public health qualifications which require that drinking water contain not more than 0.2 p.p.m. of copper. Fish present in the reservoir are also considered. It has been found in El Dorado that when microscopic organisms exist in large numbers ninety-nine per cent of the organisms are of one specie. If this predominating organism is one which does not cause trouble we do not destroy it. Such destruction might only clear the water for some organisms which are more troublesome and more resistant to copper sulfate.

Controlling tastes and odors which result from the few microorganisms which are resistant to copper sulfate to the extent that this treatment cannot be both safe and successful will test the ingenuity of the water works chemist. We have found that diatoms usually appear in late winter and early spring, followed by green algae in the summer, then blue greens in July and August followed by protozoa in the fall. Protozoa have also been found in large numbers in winter and spring. We have had no taste or odor traceable to green algae. During the two years that microscopic identification has been made we have never found a single cell of tabelleria or asterionella, which are considered common offenders.

The application of copper sulfate to the lake is accomplished by dragging burlap bags containing about 35 lbs. of copper sulfate behind a rowboat following the shore line then zigzagging across the lake in a course that will evenly distribute the chemical in the surface water. Crude as this method is, we have found it to be very effective. The bottle shown in the sketch is used to obtain samples at different depths in the lake. After lowering the bottle by the cord to the desired depth the cord is given a short jerk which removes the cork.

A. E. French




Bottle for obtaining samples

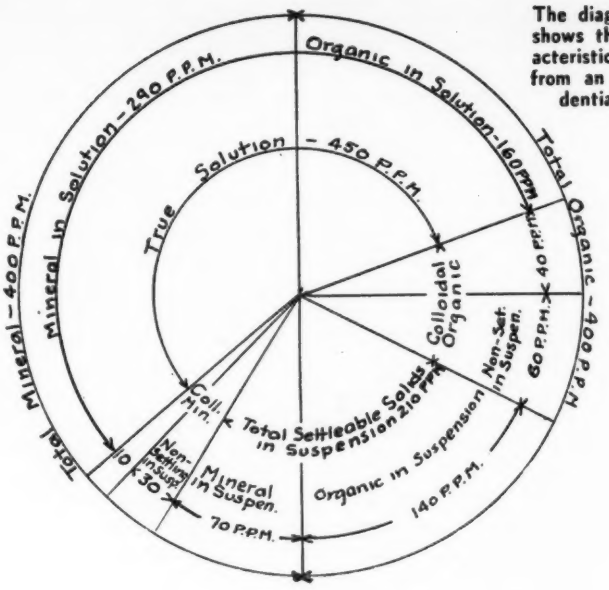
## Paying for Sewage Treatment

Under a recent agreement between the city of Louisville, Ky., and a group of distilleries located outside the city limits, the latter were granted the use of the municipal sewerage system. The distilleries have agreed to pay the city 43c per $100 of their assessed valuation for the right to dispose of their wastes through a city-built outfall sewer, and will also regulate the discharge of acids according to city specifications.

The city of South St. Paul, Minn., will construct a sewage treatment plant at an estimated cost of $960,000 of which the packing industries located in the city have agreed to pay 65%. The packing industries have also agreed to pay 90% of the maintenance and operating cost. The sewage from the packing plants is estimated to be equivalent to that from a population of 200,000, whereas the population of the city is about 10,000.

Because of this extremely heavy load of packing plant wastes, South St. Paul was not included in the metropolitan sewage district of Minneapolis-St. Paul when it was established in 1933.

Portland, Ore., has recently decided to proceed with a sewage disposal project on a pay-as-you-go basis. The project is estimated to cost $9,000,000 and will be financed entirely by sewer rentals. The charge for sewer service, not to exceed 1/3 of the water service charge against residences, was authorized in a recently adopted charter amendment. Rentals are to be fixed by a board of equalization. Sewers will be built from year to year as money becomes available through the sewer service charge.




The diagram at the left shows the general characteristics of sewage from an American residential community.

# Disposal of Garbage With Sewage

By K. C. LAUSTER
Ass't Engineer, North Dakota State Department of Health

SINCE garbage and sewage solids are essentially the same in composition, the principal difference being in the relative stages of decomposition, it would seem entirely feasible to dispose of both substances in the same manner and by the same organization. For many years engineers have been studying sewage disposal to develop better, faster, and cheaper means of treatment. In contrast, the garbage disposal situation has been poorly and inefficiently handled as a rule.

*Methods of Disposing of Garbage With Sewage.*—Three general methods of disposal are considered here:

1. Grinding of garbage in the home with household grinders and discharging into the sewer using just enough water to facilitate grinding and carrying away the solids.

2. Collecting of garbage in tank wagons, delivering to grinding stations located on trunk sewers, grinding and discharging directly into the sewer.

3. Collecting of garbage in tank wagons and delivering to grinding station at the sewage plant, grinding and discharging either into sewage ahead of settling tanks, or directly into digester.

*Discussion of Methods.*—The first method is convenient to many householders. However, the initial cost of the grinding equipment is high and the machines require considerable servicing to keep in shape, therefore it is improbable that this method will become in use universally. The second method is merely a means to save transportation of garbage for long distances. The third method is clearly just a means of disposing of the garbage. It is apparent that no transportation or other collection costs are reduced by employing this system.

*Quantity of Garbage.*—Garbage is fairly constant in quantity, varying usually from about 150 to 260 pounds per capita per year and averaging about 200. This gives 0.55 pound per capita daily. However, many reports may show much less than this, due to collection by private agencies not reflected in the city report. Further, communities where people use a great deal of canned or packaged goods will tend to produce a smaller amount.

*Composition of Garbage.*—Following is an average garbage analysis:

| | | |
|---|---|---|
| Wt./Cu.Ft. | 40 to 50# | Avg. 46# |
| Water | 65 to 80% | " 75% |
| Vol. matter | 18 to 26% | " 22% |
| Ash | 2 to 6% | " 3% |
| Vol. solids (dry basis) | | " 90% |
| Grease cont. (dry basis) | | " 18% |

Assuming 0.55 lb. of garbage produced per capita daily, on the basis of the above assumptions we have:

| | | |
|---|---|---|
| Solids (dry basis) | 0.14 | # / cap. / day |
| Vol. matter (dry basis) | 0.125 | " " " " |
| Grease (dry basis) | 0.025 | " " " " |
| Ash | 0.0042 | " " " " |

Babbitt has shown experimentally that when ground garbage is elutriated with sewage, approximately 66 percent of the garbage volatile solids and 59 percent of the total solids goes into solution or colloidal suspension. Then elutriated garbage looks like this:

Solids 0.14 $\times$0.41=0.057 lbs. per capita daily
Vol. 0.125$\times$0.34=0.042 lbs. per capita daily

*Sewage Sludge.*—From Fig. I showing the general characteristics of sewage from an American residential town, let us take the average suspended solids as 350 p.p.m. Assuming 100 gallons per capita daily flow and 60 percent removal of suspended solids we have:

$$\frac{350\times100\times8.33\times0.60}{1{,}000{,}000}=0.175 \text{ lbs. per cap. per day dry solids}$$

If the concentration of solids in the sludge is 3 percent and the specific gravity is unity, the volume occupied will be:

$$\frac{0.175}{0.03\times62.5}=0.0933 \text{ cu.ft. per cap. per day}$$

And the weight will be:

$$\frac{0.175}{0.03}=5.83 \text{ lbs. per cap. per day}$$

Assuming a 30-day digestion period this gives a sludge capacity of 2.8 cu.ft. per capita (0.0933$\times$30).

*Theoretical Sewage-Garbage Digestion Capacity.*—Assuming that all of the suspended solids of elutriated garbage will settle out during sedimentation, the total

dry solids from a sedimentation tank receiving both garbage and sewage will be:

0.175 plus 0.057 lb. = 0.232 lb. per capita per day.

On the basis of previous assumptions, the required digestion capacity will be:

$$\frac{0.232 \times 30}{0.03 \times 62.5} = 3.71 \text{ cu.ft. per capita}$$

Supposing the garbage is ground and fed directly into the digester, then we find:

| | | |
|---|---|---|
| Wt. of sewage sludge | = 5.83 lb. | per cap. per day |
| Wt. of garbage | = 0.55 lb. | " " " " |
| | Total = 6.38 lb. | " " " " |

Then the capacity necessary for 30-day digestion, assuming the specific gravity as unity will be:

$$\frac{6.38 \times 30}{62.5} = 3.06 \text{ cu. ft. per capita}$$

The increase in digestion capacity due to addition of garbage in percent can now be calculated.

1. Garbage discharged ahead of sedimentation devices:

$\frac{3.71}{2.8} = 1.32$ or 32% increase in digestion capacity.

2. Garbage discharged directly into digestion tanks:

$\frac{3.06}{2.8} = 1.09$ or 9 percent increase

3. Difference between above two methods:

$\frac{3.71}{3.06} = 1.21$ or 21% increase in digestion capacity if garbage is discharged into sewage rather than directly into digestion tanks.

*Discussion.*—The above calculations were computed to satisfy the writer's curiosity concerning the effect of garbage on the capacity of digestion tanks. At first glance, noting garbage solids usually run about 0.14 pound per capita per day and dry sewage suspended solids about 0.175, it was deduced that the required capacity would be about doubled. As may be seen, these calculations are only approximate and are based on the given assumptions. The percentage difference would vary considerably with different garbage-sewage proportions. In many cases the garbage solids would be lesser in proportion to sewage solids because of the averages assumed for domestic sewage. However, the assumption should be more illustrative of above-average cases in garbage-sewage proportions because of the absence of industrial wastes and the theory that all of the garbage of the community would be discharged into the sewage.

Rudolfs, in his discussion of Malcolm's Cornell studies, states: "In conjunction with other work on garbage-sludge digestion published recently, the Ithaca experiments show that garbage added continuously is not detrimental, but that the digestion capacity required increases in direct proportion to the quantity of volatile matter. Since none of the results indicate a more rapid digestion of the garbage or garbage-fresh solids mixtures, and no more total gas was produced from these mixtures than from the control, it may be assumed that under the conditions each pound of volatile garbage solids required the same digestion time as each pound of volatile material in the fresh (sewage) solids. Consequently, when 100 percent garbage is added (on the basis of fresh solids) the digestion tanks must be at least twice as large."

This conclusion does not appear to be unreasonable because of the fact that the volatile matter in garbage is fresher and has not undergone the decomposition that has already taken place in sewage solids; however, few other experimenters seem to corroborate this opinion. In fact, frequent statements to the effect that the addition of garbage had very little, if any, effect on required digestion tank capacities were the motivating influence which prompted the writer's curiosity.

Tolman, in his summary of several experimenters' results, concludes that garbage added to raw sewage increases suspended solids 16 percent. On the basis of the above calculations, this would mean only a 16 percent increase in digester capacity. Other investigators draw contradictory conclusions regarding the rate of digestion of garbage in heated tanks. Indications seem to point to the production of a satisfactory sludge in as little time as ten days when the garbage is properly seeded, and the temperature and pH are properly controlled (mesophilic). Also, the concentration of solids in the tanks seems to be a factor in the rate of digestion—the higher the concentration of volatile solids, the faster the rate. This would probably exert quite an effect when garbage is added directly to the digester from the grinder without any water being added.

Some experimenters feel that the garbage liquor would tend to lower the pH to the extent that this method would interfere with digestion, in which case it is preferable to elutriate the garbage by allowing it to flow through the sedimentation tanks, thereby eliminating most of the liquor from the garbage-sewage sludge. This theory has been quite successfully exploded by demonstrations which prove that garbage alone may be satisfactorily digested as long as it is properly seeded with well-digested sludge. This seeding requires mixing in the digester. The experiments at Flint show that garbage can be digested successfully when properly controlled. Sewage sludge from Imhoff tanks was mixed with ground garbage with a sewage-garbage ratio of 1 : 1.42 (dry basis). The resulting mixture, 83 percent volatile, digested readily. On the basis of 0.124 pounds per capita per day sewage solids and 0.176 pounds per capita per day garbage solids, the gas produced was 2.85 cubic feet per capita per day.

From the literature reviewed, the best method would indicate disposal of garbage directly into the digestion tank, thus avoiding diluting it with water. The rate and time of charging the digester could be much more effectively controlled and much more gas will be produced by charging in this manner because none of the volatile matter is washed away.

The household grinder is the most convenient from the standpoint of the housewife, but the control would be entirely beyond the jurisdiction of the plant operator. The degree of fineness to which the garbage is ground is a factor in the rate of digestion and in the proportion of the garbage that goes into the solution. As the grinders become dull and worn, many large pieces would probably be discharged that would tend to retard the rate of digestion and gas production considerably. Many of them would also be likely to float on the sedimentation tanks. Further, the maximum discharge would probably fall at the peak of the present load, subjecting this to still greater fluctuations. Central grinding stations, located either on an intercepter or at the plant and discharging into the raw sewage, could be controlled so that the above objections could be ameliorated.

*Acknowledgment.*—This is a portion of a paper by Mr. Lauster in the Bulletin of the North Dakota Water and Sewage Works Conference.

Luther K. Zerbe, County Engineer, and the fleet of snow plows used in Stark County, Ohio

# Beating Old Man Winter at His Own Game

By LUTHER K. ZERBE
County Engineer, Stark County, Ohio

**Good organization and good equipment are necessary to beat Old Man Winter. Prompt plowing and use of treated grits are important in keeping roads open and safe.**

SNOW removal and ice control are headaches anyway you look at it. Unlike summer maintenance, where the highway department can know in advance just about how much work will have to be done, winter maintenance and the kind and amount of it are subject only to the dictates of nature. One year the problem may be mainly snow removal, another year mostly ice control, while often it is both—in unpredictable amounts.

An efficiently organized winter maintenance system might be looked upon as the aspirin for snow removal and ice control headaches. For without such a system, a highway department functions painfully when vagaries of weather bury the county in snow or sheath the roads with ice.

Stark County, Ohio, takes pride in the winter maintenance system it set up a number of years ago. As new equipment, materials and methods have come along, we have made refinements in our system but the basic principle on which it was founded remains the same—speed of operation. The equipment and materials we use, and the methods by which we use them, are all pointed toward taking care of a maximum mileage of roads in a minimum of time.

## Organization and Equipment

To keep Stark County's 370 miles of county roads in safe winter driving condition, we have divided the county into 13 patrol districts, each comprising from 21 to 42 miles of roads. Under a district foreman, each patrol crew is charged with the job of snow removal and ice control in its patricular district. In case of neglect of duty, we know immediately where to place responsibility, though occasions making such action necessary very seldom arise.

Each patrol crew is equipped with a 1½ or 2-ton truck with light snow plow attached. Mechanical abrasive spreaders are part of the equipment of most crews. For use in heavy snows, 5 large plows are kept at the central garage in readiness for dispatch to any district. The cabs of all trucks are well-lighted—front, sides and rear—to give ample warning to motorists.

Patrol crews are on call day and night and must be prepared to move on short notice. The foreman in charge of each crew has a personal telephone and the means of assembling his men promptly at any time. We also keep a man on duty 24 hours a day to take care of incoming calls, to aid in dispatching crews, and to keep track of patrol movements.

Augmenting the employees in our own organization, we have the cooperation of a large army of all-night gas station attendants, truck and bus operators who keep us closely posted on road conditions. We have gone out of our way to enlist the services of these men and they understand that their reports to us are received not as complaints but as helpful cooperation that enables us to do our job faster and easier. Consequently, it is

The fleet of sanders ready for active duty on ice control

seldom possible for snow to fall or ice to form on any Stark County road more than a few minutes before we know it.

### Operation of the System

Route schedules for plowing and skidproofing in the various patrol districts are designed to take care of the most highly travelled roads first. Then, when traffic is moving safely on the trunk-line highways, the patrols continue operations on the lesser county roads.

Snow removal starts as soon as the falling snow reaches a depth of 1 inch, but preparations are underway long before this depth is reached. The light plows are used at the beginning of a storm but if the snowfall reaches proportions too large for the light plows to handle, the heavy plows are called out from the central garage.

After the initial plowing has been performed to keep the roads open, the plows follow through and push the snow as far as possible onto the shoulders. This is done to make room for the next snow removal and also to accelerate draining into the ditches instead of onto the road.

When the snow plows have done their work, and traffic has begun to compact the light coat of snow remaining on the highways, our patrol crews set forth with loads of calcium chloride-treated cinders and rapidly skidproof all hills, curves, intersections and railroad crossings. These same danger points are skidproofed in the case of sleet and ice storms.

We place stockpiles of abrasives in the fall at various locations throughout each patrol district. Because of the great amount of industry located in and around Canton, our principal city, we are always able to secure ample supplies of cinders, which we consider the best available abrasive material. Cinders, being light in weight, seem to move up through the snow, and present a tractive surface longer than other abrasive materials.

In slight variation of the old adage, "You have to spend money to make money," we have found that we have to spend money to save money when it comes to preparation of skidproofing abrasives. We use calcium chloride for treatment of cinders in Stark County because this material seems to be most effective in freezeproofing our stockpiles and in making the cinders stick when applied to ice or packed snow. Treatment is made at the time of stock-piling and at a rate of 100 lbs. of calcium chloride per cubic yard of cinders.

When we balanced the cost of calcium chloride treatment against the cost of using untreated abrasives, we discovered that economical considerations alone were in favor of treated grits. One truck-load of treated materials, we found, is equal in effectiveness to three truck loads of untreated material. This holds true because we can make much lighter application of the treated abrasives, which dig into the icy surface and resist the displacing action of traffic and wind.

Since even a cindered icy surface is not nearly as safe as an iceless pavement, our patrol crews stand in readiness between storms for even the slightest period of thawing weather. When it comes, fast action is taken to remove the ice or packed snow by means of motor graders, to prevent refreezing of the softened surface.

The county makes a practice of assisting the townships in removing snow and skidproofing ice after the county roads have received all necessary attention. Consequently, our district patrols are seldom able to enjoy a breathing spell of any length. Most of our boys have been at it for a good long time, though, and are pretty well accustomed to coming out on top in the tussle with Old Man Winter.

# What of TOMORROW, Mr.?

ARE you going to be *there* and know what you're talking about? Are you going to know the latest

*—in machinery?*
*—in methods?*
*—in materials?*

Today the flow of improvement and change is rapid. Whether you are a contractor or highway official, you need every advantage to meet the contingencies of your job. You've got to keep up to date. Here is the one big chance to see, to learn, to examine in detail the latest in methods, machinery and materials—the one big chance to bring yourself up to date.

Here you can meet men with the answers to many of your problems. How to obtain the best for your road money. How to maintain good relations with the motoring public. New ideas for safer highways. New ideas in highway design—better machines for more profit!

*Plan now to come to the Road Show and Convention*
**CHICAGO INTERNATIONAL AMPHITHEATRE**
**JANUARY 29 — FEBRUARY 2**
**Make Your Reservations Now!**

*Under the Auspices of*
**THE AMERICAN ROAD BUILDERS ASSOCIATION**
**National Press Building • Washington, D. C.**

MACHINES METHODS AND MATERIALS FOR THE HIGHWAYS OF TOMORROW
THE ROAD SHOW
CHICAGO
JAN. 29 - FEB. 2
1940


**The George Washington Bridge by day at left, and a part of the same view by night at the right.**

# Safety and Directional Marking Signs on the Henry Hudson Parkway

TRAFFIC safety principles, methods and equipment which are adapted to the largest projects are applicable almost everywhere. For that reason, traffic control officials and designing engineers can draw valuable lessons from the Henry Hudson Parkway, New York City's new super-highway extending for 11 miles along the east bank of the Hudson River. Into this highway has been incorporated practically every aid to trouble-free and safe driving that is known to modern highway engineering.

The Henry Hudson Parkway is illuminated throughout its entire length. Light standards, in most cases, are placed in the parking strip which forms the permanent center marker along the 11 miles of Parkway length. These strips are from 5 to 15 feet wide and are enclosed in concrete curbing. They divide the parkway into two one-way traffic lanes, each of 3-car width. Through careful planning, ample and well-marked exits are provided to secondary routes, despite the fact that sufficient space was not always easily obtainable, the parkway being sandwiched between the city and the river.

Throughout the entire length, route numbers, direction signs and traffic control signs are provided in abundance so that even the stranger to New York may find his way surely. To provide for the control of night traffic, the signs are of the day-and-night reflecting type, as visible and easily read at night as in the daytime. The photographs herewith show the legibility of these signs under both day and night conditions, but they do not accentuate unduly their nightime appearance.

An important feature is a system of marking all exit routes with numerals—a practice found most helpful on the Long Island parkways. This permits of easy direction by traffic officers or others. With the 24-hour a day markers and with the full, easily read and complete direction signs, the Henry Hudson Parkway is one of the country's safest and most easily followed routes.


**From the signs alone it is difficult to tell day from night.**

# Use of Sewage Effluents in Irrigation

## A resume of practice in the Western areas of the United States, with special reference to permissibility, desirability and economic use

SEWAGE irrigation was probably the earliest method, other than dilution, utilized for disposing of sewage. Using untreated sewage, it was far from being a satisfactory one; it was unsanitary, clogged the soil, compulsory use when the crops did not need it was injurious to many of them, the area required for large communities was almost prohibitive, and the fertilizing quality of sewage was found to be less than expected. As communities increased in size and in appreciation of sanitation, as industrial wastes rendered the sewage even less desirable, and as other and better methods of disposing of sewage became available, these largely replaced irrigation.

But while irrigation as a method of disposing of sewage has practically disappeared, the use of sewage for irrigation has continued and even increased in areas where irrigation is a necessity. In a study of the subject made by the Bureau of Agricultural Engineering of the U. S. Dept. of Agriculture during the past five years, sewage irrigation was found in operation in 113 localities in 15 States. Most of the material in this article is derived from the results of this study.*

The municipalities where sewage irrigation was studied included 4 in Arizona, 47 in California, 1 in Colorado, 2 in Idaho, 2 in Kansas, 3 in Montana, 3 in New Mexico, 2 in Oregon, 32 in Texas, 4 in Utah, 2 in Washington, and 1 in Wyoming. These take sewage directly from outfalls or disposal plants. In addition, irrigation with sewage diverted from public stream channels is practiced by 1 community in Arizona, 5 in California, 2 in Colorado and Oregon, and 1 each in Nebraska, Nevada, New Mexico, South Dakota, Texas, Utah, Washington and Wyoming. This list is known to be incomplete but is believed to cover a large percentage of the total number.

While use of the second class listed above might not be classed as *sewage* irrigation, the water in the streams used can be called diluted sewage; in fact, during the dry seasons the only water entering some of the streams is sewage effluent. Even the South Platte river at Denver, in 1934 was 38% untreated sewage (a treatment plant was built in 1937); and more than half of the Ogden river in that year was untreated sewage from the city of Ogden.

Eleven instances were found where sewage irrigation has been discontinued. In several of these, either the soil or water was unsuitable or the area of land available was insufficient. In some cases the land was too tight or too heavily impregnated with alkali. In one, the water was too salt. Other reasons were substitution of dry farming for irrigation; availability of abundant irrigation water; unsatisfactory experience of the city with the lessee; unprofitableness; and new State health regulations.

* "Sewage Irrigation as Practiced in the Western States," Wells A. Hutchins, Technical Bulletin No. 675, U. S. Dept. of Agriculture.

### Permissibility of Sewage Irrigation

While irrigation with crude sewage is not now considered permissible from a sanitary point of view and would seldom be profitable, there may be many localities where use of partially or fully treated effluents would be both profitable and permissible, as a means either of treating sewage or of irrigation or both.

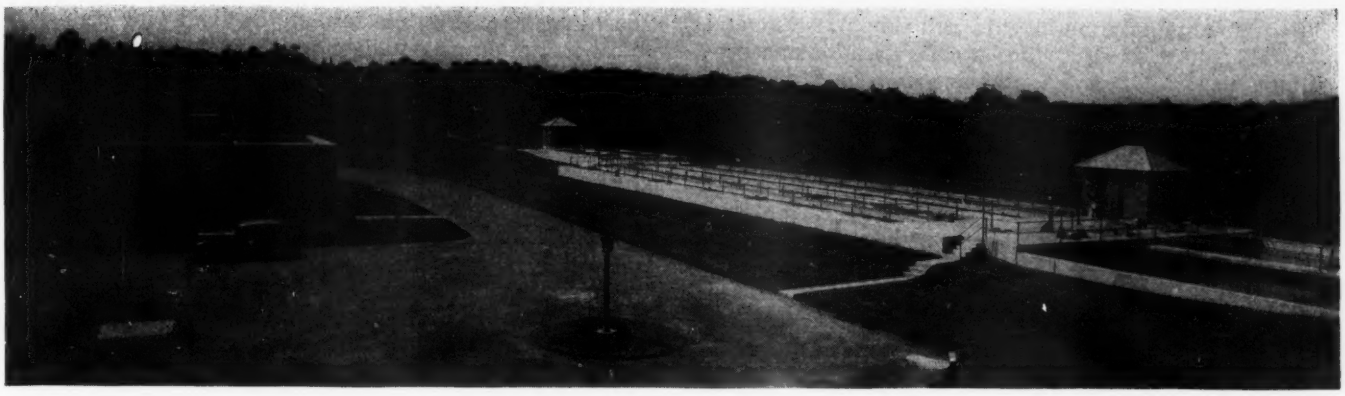
Considering first permissibility: This is chiefly a question of the danger of the contracting of disease by either workers on the irrigated land or those who use as food the crops grown thereon. What danger there is of this is due chiefly to the presence of certain bacteria in the sewage. In so far as these are reduced this danger is lessened; a sterile effluent would be harmless from a sanitary point of view.

It is generally considered that crops not eaten in the raw state by humans can be irrigated with sewage with little danger. And that, on the other hand, it is not permissible to irrigate, with any effluent, strawberries or any fruit or vegetable that grows under or within a foot of the ground and is ever eaten uncooked.

Among the dangerous practices in irrigating with sewage are: Using open ditches for carrying effluents that are not sterilized, particularly along or across public roadways (uninformed or careless persons may use it for drinking or washing). Cross connections between ditches carrying effluents and unpolluted water through which it is possible for the former to reach the latter and so reach berries etc. for which only the unpolluted water should be used. Irrigating orchards with effluent while or just before fruit, grapes etc. fall to the ground.

As is the case with shellfish and other foods, the protection of the public from the danger of sewage irrigation is considered a duty of State or Federal governments, usually performed through health boards. Several of the States or their health boards have adopted more or less definite regulations on the subject.

Irrigating with sewage or sewage plant effluents is illegal without obtaining permits from the State health department in Arizona, California, Colorado and Washington. In Kansas and New Mexico the State board has police powers but prefers persuasion. Colorado forbids the use of domestic sewage, or water containing domestic sewage in which bacteria of the coli-aerogenes group are present in quantities of 10 per cc or more, for irrigating any fruits or vegetables grown for human consumption, the edible portions of which grow in the ground or above it within 1 ft. of the surface, except by special permit. In Arizona, no permit is issued if the crop raised can be used without processing (as by heat) that will destroy disease organisms. California prohibits the use of untreated sewage containing human excrement for irrigating any growing crops; and use of partially disinfected effluents for vegetables, low-growing fruits, or vineyards or orchards when windfalls and fruit lie on the ground; and pasturing milk cows on land moist with sewage; but these restric-



# Popular For Small-City Plants as well as Large . . .

## NORTON POROUS MEDIUMS

THE engineers for the Leominster, Massachusetts activated sludge plant (an excellently designed small-city plant) specified Norton Porous Plates to prevent aeration and diffusion troubles.

Norton Porous Plates and Tubes can be depended upon for uniformity and long service. They provide insurance against costly and annoying maintenance. Their serviceability has been proven in many world-famous activated sludge disposal plants over a period of many years.

**NORTON COMPANY, WORCESTER, MASS.**

**NEW YORK CHICAGO CLEVELAND**

R-641

tions do not apply to well oxidized, nonputrescible and reliably disinfected or filtered effluents. Montana prohibits the sale of any vegetables grown on farms irrigated with human sewage. The health boards of Oregon and Texas advise against irrigating any crops that may be eaten raw or lands where milk cows are pastured; the latter believes that there is an aesthetic undesirability and some hazard in irrigating with sewage effluent any food stuffs intended for human consumption; the former believes that completely treated or well oxidized effluents, disinfected with chlorine, may safely be used for some kind of crops. The Kansas board of health prefers that effluent used for any crop be chlorinated to protect the field workers, while its use undisinfected on vegetables involves a hazard.

It is generally agreed that the fertilizing and irrigating value of the sewage applied, important as it may be in crop production, is secondary in public importance to freedom from disease-producing organisms. The fact that sewage has passed through some kind of treatment plant does not insure that it is innocuous. Chlorination or other chemical disinfection of the effluent, or filtration for bacterial removal, is desirable. But while it is theoretically true that any kind of irrigation water that does not meet the recognized bacterial standards for domestic water is a potential source of danger, no instances were found, in the study made as the basis of this report, where epidemics were traced definitely to irrigation with sewage in which the B. Coli content had been substantially reduced, even though the drinking water standard was not attained; and in only a few cases have individual cases of illness been suspected of coming form such sources.

Aside from the *danger* of using sewage effluents, aesthetic considerations are important. Even if the vegetables grown are always eaten cooked, many people object to eating or even bringing into the kitchen any that have been irrigated with sewage; and if many consumers so object, the marketability may be impaired, not only of these but of similar crops grown in the same locality.

But from either health or aesthetic considerations there appears to be little objection to irrigation, with effluents at least partially purified, of grain, sugar beets, alfalfa (cut after the ground has dried), vine and tree fruits picked a sufficient length of time after irrigation to insure thorough drying of the top soil, or of seed crops or textile crops.

Pasturage of dairy cows on sewage-irrigated fields has been suspected of causing tape worm, and there is the possibility that the cows' udders may come in contact with sewage flowing in a ditch or recently applied to the land.

Pollution of ground water by irrigating water seems to be a minor consideration. If more water is applied than is used by the crops, and the surplus reaches rock crevices or open gravel formations where the ground water flow is toward wells or other sources of domestic supply, there may be danger. But if the soil is fine sand, clay or other compact soil, there seem to be little probability that contained bacteria will travel more than 200 to 400 ft., and in most cases much less than this.

## Desirability of Use

Irrigation as a means of sewage disposal, subsequent to settling or other primary treatment, may give the best results obtainable at reasonable cost in some cases. Several cities have no stream within reasonable distance to receive the sewage effluent, or only a stream which becomes nearly or quite dry during several weeks of each year. In the former case it seems imperative to turn the effluent upon the land, and farming the land with methodical irrigation may well be worth while—may even be necessary to prevent causing a nuisance. In the latter case, a high degree of purification of the effluent is necessary, especially in the dry season; and irrigation may be the cheapest method of effecting this. And there are other conditions under which, where sanitary considerations call for further purification of a primary effluent, irrigation may be the cheapest or most feasible method of effecting it.

Irrigation with sewage for the purpose of raising crops is generally desirable under the same conditions as is irrigation with unpolluted water. But there are some differences to be considered. Coarse texture of the soil seems to be more important with sewage than with clear water. The diversity of crops that can be grown may be more limited by both state laws and those of vegetable growth. But the general experience seems to be that almost any crops grown by ordinary irrigation in a given area will do as well or better with sewage irrigation. The favorite crops in California are small grains, field corn, alfalfa, fruits and vineyards; in Texas, small grains, field corn, vegetable and other harvested crops. In only 3 of the farms studied were berries grown. Grain, corn and alfalfa predominated generally in all states.

There may be constituents of the sewage effluents of some cities that reduce their value for irrigation. Some effluents, especially where considerable amounts of trade wastes reach the sewers, may contain salts that are unfavorable to the growth of certain plants. Excessive salt content injuriously effects the growth of some, excessive alkali that of others. Studies made in California indicated that boron (which is found in waste from packing houses that use borax for washing fruit), while essential in some quantity to the growth of many plants, is extremely toxic to many if present in soil solution in concentrations above a few parts per million. (The critical concentration for lemons and walnuts lies between 0.5 and 1.0 ppm.) As to chlorine, 100 ppm is considered the danger line for avocados, while it apparently may approach 350 ppm for other crops. Chlorine residuals from disinfection are so much below these amounts as to be unimportant

## Water Rights in Sewage

Sewage, where the water supply from which the sewage is derived is drawn from a stream, apparently is one form of "return flow after diversion of water for beneficial use" which is covered by the laws of several states. The courts in some states adhere to the public ownership theory of return flow, which means that return waters (unless appropriated from a different watershed) are not the private property of the appropriator; while other states admit such private ownership. It would appear that, in the former group of states, municipal waters appropriated from streams for public use may not be used again for irrigation before being returned to the stream; although where use for irrigation was a reasonable feature of sewage treatment the courts have not interfered. No Supreme Court decisions involving the right to re-use sewage from cities having underground water supplies are known; presumably such right exists unrestricted in all states.

## Economic Aspects

The use of any irrigating water by farmers will be profitable if the purchase and distribution of it costs less than the increase in value of crops made possible thereby. Sewage effluent may have a slightly greater fertilizing value per acre-foot than unpolluted water, but there are

no figures available for determining the amount of this. There is, however, an undoubted advantage in some cases in that the supply of effluent is generally reliably constant, while the other may fall off considerably during dry seasons.

Restrictions as to crops that may be raised with effluent under State regulations may be an important consideration. The grain crops, for which such restrictions are lenient, usually do not yield as much return as those for which a high degree of purification of the effluent is required. If such high degree of purification of a city's sewage is required, even if the effluent is discharged into a stream, the charge to the farmer need be no greater for irrigating garden truck than for the less remunerative grain. But if such high degree of purification is not required unless the effluent is to be used for irrigation, then the cost of the additional purification required should be charged against the crops requiring it, and it might well be that this additional cost would exceed the higher return obtained from such crops.

The cost of irrigating with effluent includes not only the cost of effluent itself at the plant, but also that of the ditch or pipe for bringing it to the farm and the distribution channels thereon; and because of the suspended matter carried, the putrescibility of the effluent if standing in depressions, and the probability of more prolific growth of weeds in the channels, this cost is generally somewhat greater than for unpolluted water.

In general, to determine if it would be profitable to use sewage for irrigating a given piece of land, it is necessary to calculate the annual cost (including interest and depreciation on canals etc.) of the sewage and its use, and the annual returns therefrom, and compare these with similar estimates for river or well water irrigation; and, in making the comparison, take into consideration the greater reliability of the continuous supply of sewage in dry seasons, the relative suitabliity of the two waters for the crops to be raised, and the effect on the marketability of food raised for human consumption. Of course, where no water other than sewage is available, the calculation is limited to a comparison of total cost with crop returns obtainable.

The charge made for the sewage itself varies greatly in different places. Perhaps the majority of municipalities make no charge for it; and if there is no near outlet into a stream, may even provide the ditch for bringing it to the farm. This is especially probable if, by furnishing partially purified sewage for grain irrigation, the city is relieved of the cost of additional purification which would be required by the State health authorities if the effluent were discharged into a stream.

In some cases the city owns land near the treatment plant, and leases this land, the lease including the privilege of using the sewage for irrigating it. In a few cases the city itself operates a farm or orchard on such land. The latter has the advantage that the city is able to prevent unsanitary practices, which is sometimes difficult with private operation. In Pomona, Calif., an irrigation company pays a substantial amount for the exclusive right to the continuously chlorinated effluent from an activated sludge plant for use in irrigating orchards.

## A Question in Practical Politics

The following letter from a western reader is self explanatory. Has any one suggestions to offer?

"I have been county engineer of this county for 17 years and would like to know how to handle commissioners who are elected to office from farms and business and at once consider themselves road experts and civil engineers.—*(Continued on page 36.)*

"I would like to see a campaign in our various magazines on this subject. It would relieve both the commissioners and the engineers of many a headache, give the public better, cheaper and more roads for their money.

"But how are you going to teach men who know not and know not that they know not?"

## Repairing a 48-Inch Brick Sewer

A two-course 48-inch brick sewer 1400 ft. long, built about 1906, carries the bulk of the domestic sewage of the south side of Fargo, N. D.; although a parallel 48-inch concrete sewer, built later, carries overflow storm water. When examined during an annual sewer inspection about three years ago, over 400 ft. of it was found to have spread about 6 in. at the spring line and settled the same distance at the crown, with longitudinal cracks along the crown, invert and both spring lines. This was probably due to insufficient side support by the backfill.

During the first three months of 1938 this was repaired by WPA labor, for which it was an ideal job. The plan was to remove the brick in the arch, clean them and relay them in an arch of 27 in. radius. But the mortar was so hard that it could not be removed from the brick, so the plan was changed and the two half-arches were used intact, being spread to the 27 in. radius and the crown of the arch filled with new brick. The resulting arch was not a true circle, but the old brick work was so solid that it was believed it would be sufficiently strong.

Excavation was made by hand down to the spring line and 8 in. wider than the sewer on each side. Then, at 8 ft. to 12 ft. intervals, a transverse section of the arch about 2 ft. wide was cut out. A longitudinal timber was set at each spring line, on the inside, and these were held apart by trench jacks to prevent the sides from moving in. A piece of heavy tin was placed under the intrados, and under this were placed three timber arch centers cut to the 27 in. radius. A longitudinal timber was placed under these three centers and jacked up until the top of the arch was approximately 54 in. above the invert, the two arch sections separating at the top. The longitudinal opening at the top and the transverse openings between sections were then fiilled in with brick, the tin acting as a form. It was found impossible to cut out the old bats to permit toothing in the new brick with the old, so the two were butted together. To prevent the arch being again forced outward by the weight on it, a dry mix of 1 part cement to 5 of bank-run gravel was tamped outside the arch to a height of 8 in. above the spring line.

Raising the arch sections opened the crack along each spring line, and these cracks were filled with cement mortar placed with a cement gun. The longitudinal crack along the invert also was cemented, the sewage meantime being diverted to the parallel concrete sewer.

Repairing 419 ft. of sewer in this way cost $1.30 a lineal foot for material, equipment and foreman. If a new arch had been built with new bricks, the cost of these alone would have been about $2 per foot. The foreman in charge of the work was Erban Anderson, foreman in the street and sewer maintenance department. H. A. Swanson was city engineer. When examined in April 1939, the work was found to be in good condition.

## Halving the Costs of Stabilized Gravel Roads

OAKLAND County, Michigan, has found how to double the amount of gravel placed and consolidated on its secondary road for each dollar spent. According to John H. Barr, assistant highway engineer, "Necessity was the mother of invention. Last year 50 miles of roads were regraveled under a W. P. A. grant with a well-balanced stabilized mix purchased from commercial plants in the vicinity. However, it was discovered that the project fell far short of adequately resurfacing the county's secondary roads. Many of these had been badly worn by traffic without replacement of lost materials."

Use of a stabilized mix seemed necessary to prevent the rapid loss of gravel by ravelling. But stabilized mix from commercial plants was costing $1.08 per cubic yard. This cost could be reduced if the special processing of pug mill mixing could be eliminated. It was known that pits in the vicinity ran a pretty well-balanaced mix of fines and aggregates and it was believed that, by selecting pits whose materials most closely resembled the mixture desired, the cost of pug mill mixing would be unnecessary.

Tests were run on the gravel in the various pits in the area, and owners and operators were contacted and specifications discussed with them, and they were found eager to cooperate. The specifications called for 100% of the gravel to pass a ¾" screen, 55 to 80% a ⅜" screen, 25 to 40% a No. 10 screen, and 5 to 15% a No. 200 screen. The P. I. must be not less than 4, figured according to the old Dow method. This was found to require crushing about 25% of the material retained on a No. 4 screen, and supplying some clay at times to bring the 200 mesh material up to the required 5 to 15%. The county stations a man in each pit to check every load and see that it meets specifications. Samples of gravel are taken from the conveyor belts and analyzed, and a record kept of the results. Commercial pits are furnishing the gravel at 42 cts a cubic yard.

No adding materials and mixing on the road are necessary, but the material is spread on the surface and calcium chloride applied, the material having first been sprinkled with water; except that no water is used if the road has previously been consolidated.

Mr. Barr states that to date this system has proved highly successful. The roads upon which the pit-controlled gravel has been used have stood up well under traffic wear, are easily maintained, require less blading, and are free from dust. By using this method the county is able to get six to eight inches of consolidated gravel into the base instead of the customary three to four. Pit owners and operators say that this system costs them less and gives them a better margin of profit.

Oakland County Road Commission is asking for 100,000 yards of this pit-controlled gravel mix for Oakland County roads this year.

### Contractor's Liability Policy Coverage

A bridge construction company held a public liability policy covering damages to any person not in its employ on account of bodily injuries suffered "as the result of an accident." The Illinois Appellate Court held, 289 Ill. App. 608, 7 N. E. (2d.) 626, that the policy covered losses and expenses incurred by the insured in defending a suit by a person not employed by it who was shot without provocation by its superintendent. While there is diversity of opinion on the point, the court followed the weight of authority holding that the injury was accidental within the policy provisions.

# Standard Ratings for Bituminous Surfaces on Various Type Bases

PAST experience has shown that two observers of the same project may form widely variant ideas while interpreting their visual observations. The following classification has been prepared by the Bureau of Materials, Missouri State Highway Department, in an attempt to reconcile the various viewpoints and standardize the rating assigned any specific project by different observers. These data are furnished through Highway Research Abstracts.

Six classes are designated, descending from Excellent to Failure. These grades and the symbols used to represent them on the condition report are as follows:

| | | | |
|---|---|---|---|
| Excellent | — E | Average | — A |
| Superior | — S | Poor | — P |
| Good | — G | Failure | — F |

Several items are listed in defining the characteristics of each class. It is quite probable that few, if any, projects will possess all the characteristics of but one class. In such circumstances either one of two methods of description may be used. If, for example, the project has some of the defects as listed under "Average," as well as some listed under "Good," the assigned rating might well be given as "A to G." A more detailed record would show, for example, A 1-2-7b G 3-6, referring to the numbered items listed in each class.

Further definition of some of the terms used in prescribing the different classes might be desirable. Accordingly, the following limits are offered for possible guidance. The percentages are given as that part of the total area of the project.

| | |
|---|---|
| Few, slight | Less than 5 per cent |
| Some | 5 to 15 per cent |
| Considerable | 15 to 30 per cent |
| Extensive | More than 30 per cent |

The grades and their determining characteristics are as follows:

### Excellent

1. No major or minor defects are apparent.
2. There is no evidence of any surface maintenance.

### Superior

1. There are no base failures or other major defects.
2. No maintenance has yet been necessary.

This class is characterized by the occurrence of any or all of the following:

3. Slight surface roughness is noticeable, due to small waves or skin wrinkles.
4. A few small areas are cracked.
5. The riding quality is impaired but very slightly.

### Good

1. No base failures are present.

There are present any one or more of the following:

2. Some surface roughness.
3. Some cracked areas.
4. Slight ravelling of the armor coat along the edges.
5. A few small areas are distorted and crumbled.
6. Traffic is slightly inconvenienced at these points.
7. Maintenance has consisted of patching the armor coat where it has ravelled at the edges or in outer traffic lanes.

### Average

The presence of any one or more of these listed items will serve to define this classification:

1. Some localized base failures and other major defects are noted.
2. Considerable surface roughness is present.
3. Considerable areas are cracked.
4. Some armor coat ravelling is noted, especially in the outer traffic lanes and along the edges.
5. Some areas are distorted and crumbled. These are confined to the outer traffic lanes, edges or to cuts underlain by a layer impervious to water.
6. There is some inconvenience to traffic because of the infrequent failures.
7. Maintenance has consisted of any or all of the following:
   a. Patching and sealing the armor coat anywhere throughout its width.
   b. Repairing distorted and crumbled areas.
   c. Scarifying and recompacting local failed areas.

### Poor

This class is indicated by the presence or occurrence of any or all of the following items:

1. Considerable areas show base failures and other major defects—confined mainly to the edges, outer lanes and cuts underlain by an impervious layer of soil, shale, hardpan or rock.
2. Extensive surface roughness.
3. Cracked areas are extensive and frequent.
4. The armor coat has ravelled considerably throughout its width.
5. Considerable areas are distorted and crumbled and not confined to any certain location.
6. Traffic is inconvenienced to the extent of reducing speed and considerable dodging is necessary in order to avoid the failures and potholes.
7. Maintenance has consisted of any or all of the following operations:
   a. Considerable scarifying and recompacting.
   b. Extensive patching.
   c. Installation of drains.

### Failure

This grade may be recognized by the following descriptions:

1. Base failures and other major defects are numerous and extensive and their occurrence is not determined by any one particular set of conditions.
2. Distortion and crumbling are very extensive.
3. Further maintenance as present type of road would be useless and necessary repairs would entail unwarranted expense.
4. Traffic is greatly discommoded and may have to be assisted or detoured in particularly bad weather.
5. Reconstruction is the only logical solution.

## Water Department Handles It Coming and Going

In Kenosha, Wis., the water department not only designated as a "water supply protection works" and financed with water department funds. This was done because the city had no other satisfactory collateral to offer for a federal loan. The Wisconsin Public Service Commission gave the city permission to place a $500,000 first mortgage against the water works, and on the of the city's sewage, the sewage treatment works being basis of this it obtained a 45% PWA grant for building a treatment plant that had been ordered by the State Board of Health.

## Modern Equipment Speeds Concrete Paving

*(Continued from page 11)*

the cement to the enclosed weighing hopper. When it had been weighed, the cement was droppd into batch trucks on top of the aggregates through a rubber extension tube. To prevent the loose cement from blowing away, each truck had a canvas cover which overlapped all around and was weighted on the edges.

The immediate result of this constant attention to detail was an always safe surplus of material on hand (with very slight demurrage costs), and the ultimate result was that neither a crane break-down nor even a delay in shipping kept the contractor from pouring 600 or more six-bag batches of concrete in twelve hours day after day. Maintenance of that speed with a single-drum Rex mixer meant spreading a batch every 72 seconds. North Carolina specifications require 60 seconds minimum mixing time.

The number of trucks used on a given day was governed by the length of the haul. Six trucks were allowed for the first mile of hauling distance and two more trucks were added for each mile thereafter. As pouring averaged in excess of 6000 feet per week, the truck foreman was able to park two trucks each week.

As might be adduced from the statistics given in the preceding paragraph, there was always at least one truck waiting at the paver. The moment a mixed batch of concrete was discharged into the spreader-bucket the mixer operator telescoped the two operations of recharging the drum and spreading the batch. He set the skip pan in motion and while it was rising he dumped the spreader-bucket. By the time the bucket had come back down the boom, the skip had emptied itself completely and could be lowered and refilled by the waiting batch truck. Incidentally, after the concrete had been spread with the bucket it was cut by only two men, both wielding a shovel in each hand.

In considering final results, the most important factor in any paving job is *yield*. This is the delicate balance which must be maintained between concrete which is weak from lack of correct proportion of mix and so falls below inspection standards, and concrete which is costly from the same lack.

To insure correct yield, aggregate scales should be tested frequently during operations. However, on their project, an additional precaution was taken. Instead of occasional moisture tests taken on fine aggregate only, a complete record of moisture was kept, based on tests of both aggregates taken every thirty minutes during operations.

The process used to determine the amount of moisture in the materials represents a radical departure from previous methods in North Carolina highway inspection. The old method was to weigh a small amount of wet sand, dry it over a flame, and calculate percentage of moisture from the difference in weight of the same sample of sand wet and dry. The newer process is as follows:

1. Fill specially built metal container with water up to mark at bottom of calibrated glass tube.
2. Weigh carefully 2000 grams of sand taken directly from batching hopper.
3. Pour sand into container and spade for complete saturation.

4. Read percentage of moisture directly from the calibrations indicated by the height to which the water rises in the tube.

In determining moisture in coarse aggregate, dry stone is first put through a process similar to that described above, using the larger container, in order to discover the specific gravity of the stone. Then the same process is repeated with wet stone and the moisture percentage is determined by the difference in specific gravity of the same amount (50 pounds) of stone wet and dry. Stone moisture on the Charlotte to Concord paving job rarely exceeded one half of one per cent which amounted to twelve pounds in a 1:2:4 mix.

Dimensions and calibrations for the containers described here, together with specific gravity tables, can be secured from the North Carolina highway's department of Materials and Tests.

This careful measuring of moisture content meant that the amount of water added to the concrete at the mixer had to be changed as often as twice an hour and on some days it actually was changed as many as 20 times during the day's run. Such painstaking attention achieved the phenomenon of yield that rarely overran or underran more than one per cent, and that phenomenon greatly facilitated calculation of yardage, linear feet of concrete poured, and estimation of the number of batches needed to pour up to and stop at an expansion joint. The basic mix was 1:2:4 with 6.4 gallons of water for each 94 lb. bag of cement to meet a 14-day strength requirement.

The representatives of the Highway Department on this job were L. B. Peck, division engineer, 7th Div.; M. E. Beatty, assistant division engineer; J. A. Carpenter, resident engineer and chief supervisor; J. D. Hord and R. G. Holden, senior inspectors; E. M. Tinison and L. S. Ford, junior inspectors; and R. M. Bickett and W. C. Anderson, acting junior inspectors.

Marvin L. Rea was owner and superintendent of the Rea Construction Co.; C. D. Sumrell, foreman of the designing plant; M. Woodleaf, mixer foreman; Arthur Young, fine grade foreman, and Harvey Owens, truck foreman.

There were ten men employed at the plant and an average of 65 on the roadway.

## Freezing a Service Line Expedites Reconnecting

A one-inch service line in Auburn, Wash., which had to be moved, was frozen with dry ice to simplify the process of reconnecting. B. C. Gosney, water works superintendent, reported his experience at the annual Washington short school, as follows:

"Having occasion to move a 1-inch service line, which was connected to an 8-inch main, located under a paved street, in a commercial district, we were confronted with the problem of breaking the pavement or shutting down the 8-inch line, neither plan being very satisfactory due to the large area being served by the 8-in. line. We decided to experiment. We secured about one pound of dry ice, placed several thicknesses of paper under the 1-inch pipe then placed the dry ice around the pipe, folding the paper around the ice. In about ten minutes the pipe was frozen solid. We then cut the pipe and put the new line in place with a curb cock at the meter setting. We then uncovered the ice and poured water on the pipe (that is, the frozen section) until the meter began to turn. The entire operation took about 30 minutes and saved a lot of hard work, expense and inconvenience.

## Waste Chlorinated Water Used to Treat Sewage

East Baton Rouge, Louisiana, is building, at a cost of $400,000 and as a PWA project, a sewerage system to serve 5,000 workers in a residential subdivision just north of the city limits of Baton Rouge, known as Sewer District No. 3. East Baton Rouge Police Jury, which is sponsor for the work, stated, in its application for a project, that "the health of the community has been seriously menaced by unsanitary conditions due to septic tanks overflowing into open ditches."

The project consists of a network of 8" to 18" mains, with 6" connections from mains to property line; a lift station by which the sewage from 290 acres of low land in the southern part will be raised into the mains serving the northern section; and an outfall into a bayou at a point about 1,000 ft. from its outlet into the Mississippi.

About a quarter mile above the proposed sewer outlet, a chemical plant discharges waste chlorinated water into the bayou which, the engineers say, will provide ample disinfection of the raw sewage.

The Mississippi river, where the bayou enters it, has a minimum flow of 109,000 second-feet (based on the minimum recorded stage, that of September, 1925), which is estimated to afford sufficient dilution for the sewage of a city of 15,000,000 inhabitants. The sewage of Baton Rouge is discharged 3.5 miles below the proposed outlet of this system, while the nearest intake along the river is at Donaldsonville, 57 miles downstream.

It is expected that one year will be required to complete the project, upon which a force of about 400 men will be employed.

## The Cost of Reading Water Meters

Based on 3,329,923 meter readings in 78 plants, the American Water Works & Electric Co. reports that it cost 4 cents for each meter reading. On the basis of quarterly and monthly readings, each meter was read, on an average, slightly more than 6 times a year, and the average annual cost per meter customer was 25 cents a year. These figures cover the reading of 568,660 meters; the smallest installation contains 4 meters; next smallest 5 meters; other small plants have 38, 45, 46 and 52 meters.

For plants which have a small number of meters, the cost per meter reading is larger; on the four plants having 38, 45, 46 and 52 meters, the cost varied from 8 to 13 cents per reading. At five plants having 234 to 373 meters, which were read monthly and quarterly, the cost per meter reading varied from 4 to 10 cents—averaging 6.8 cents. At three plants having approximately 1,000 meters each, the average cost was 6.3 cents per reading, but varied from 3 cents to 11 cents.

At six plants having between 2,000 and 3,000 meters, the cost per reading varied from 2 to 14 cents, but averaged 5.67 cents per reading. At nine plants having 5500 to 6000 meters, the costs per reading were 8 cts. in one, 5 cts. in three, 4 cts. in two, 3 cts. in two and 2 cts. in one; an average of 4.33 cents.

Incidentally, the company estimates that the meter reading staff walked about 95,000 miles in their "appointed" rounds. The costs given include salaries and wages of meter readers, supplies, other expenses incidental thereto, extra reading of meters to ascertain consumption rates between regular readings, and rereadings. Factors affecting cost of reading include density of population, location of meter and climatic conditions.

# The Sewerage Digest

**A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published**

### Automatic pH Recording For Controlling Sludge Filtration

Tests of controlling the conditioning of sludge for filtration by use of an automatic pH recorder, conducted at the Calumet Works of the Chicago Sanitary District, show that continuous recording is not difficult of either sludge or filtrate. The most important advantage is aid in economizing on ferric chloride, especially where large quantities are used. The attendant may then reduce the dose by small increments and know the effect of each change, and the point of most economical operation may be approached without danger of blanking the filter cloth.

The recorder used employs a sealed glass electrode in conjunction with a saturated calomel half cell in a potentiometric circuit and the cell chain is completed through a saturated potassium chloride bridge. The potential generated at the electrode surface is impressed upon the grid of an electronic amplifier in a small shielded cabinet, which in turn is enclosed in a larger metal cabinet with the electrode vessel and half cell. The liquid to be tested passes through the electrode vessel, which is placed at the sampling point; while the balancing, standardizing and recording mechanisms are placed about 100 ft. away; the two being connected by two cables, one with 4 conductors, the other with 7. The potential developed on the glass electrode is balanced against that developed by the calomel half-cell by means of a mirror galvanometer and a photo-electric cell.[H1]

### Sludge Gas and City Gas Used Together

Greenwich, Conn., is using both sludge gas and city gas in the same boiler plant whenever the supply of sludge gas alone is insufficient. A diaphragm regulating governor on the city gas line is controlled by pressure in the gas line beyond the junction point of the city and sludge gas lines, so that, if sludge gas pressure falls off, city gas is admitted; a gas check valve in the sludge gas line preventing the city gas from backing up into the sludge gas line. An automatic gas valve contains elements for modulation of the gas flow (sludge or mixed) to maintain uniform boiler temperature, as well as complete shut off from high temperature, pilot failure or low gas pressure. Pilots are arranged to burn either kind of gas or a mixture. The burners work satisfactorily with either, but less air is required for sludge gas than for the other. The air supply is adjusted manually.[H2]

### Sludge Gas Heats Flocculating Basin

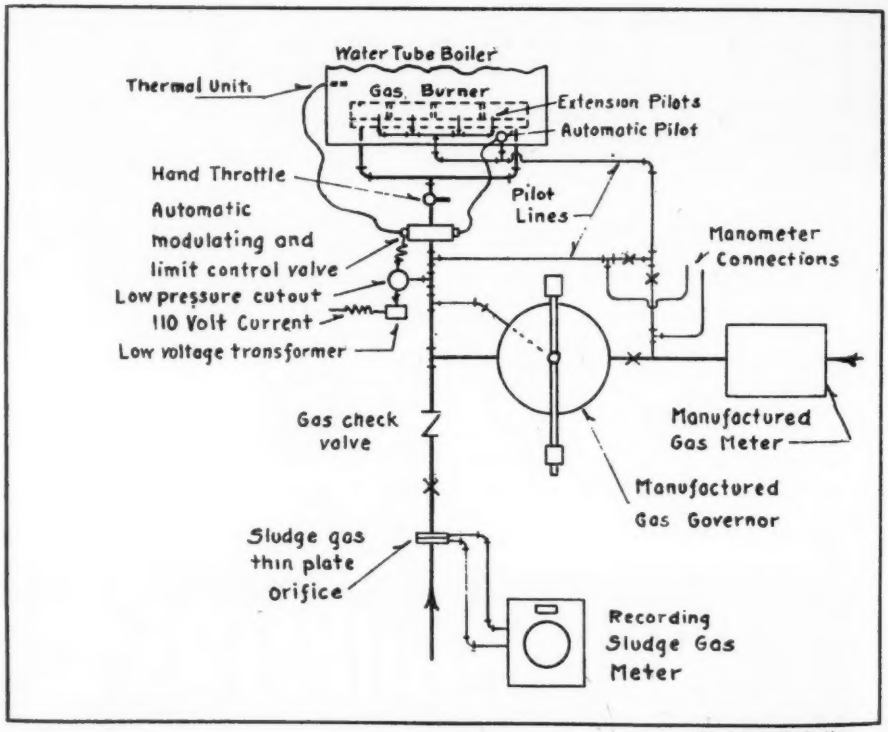
Albuquerque, N. M., has installed a treatment plant in which digester gas is used in a 150 hp gas engine, in the laboratory and for hot water heating. The gas engine is direct connected to a 110 kva generator. The engine cooling water system consists of heat exchangers in the flocculating basin and in the primary digester; when more heat is reaching the digester than is needed, the surplus hot water is turned into the flocculating basin heat exchanger. The plant can be operated solely by its own power plant, or by the public utility system, or by the two in parellel.[E5]

### Flash Drying of Chicago Sludge

Tests conducted during several years by the Sanitary District of Chicago on a plant scale, trying several methods of sludge drying and burning, demonstrated that flash drying utilized all the fundamentals of successful drying at an economical cost. The desirability of separating the drying and combustion operations was definitely proven. Also, separate drying and burning was found to lend itself to extremely accurate and flexible control, and burning in suspension to be economical and desirable. The Calumet works contains 3 flash-type drying units with independent furnaces and high temperature preheaters, each unit handling 20 tons of dry solids per day when drying filter cake of 80% moisture. The Southwest plant contains similar equipment with a capacity of 375 tons of dry solids a day.[C7]

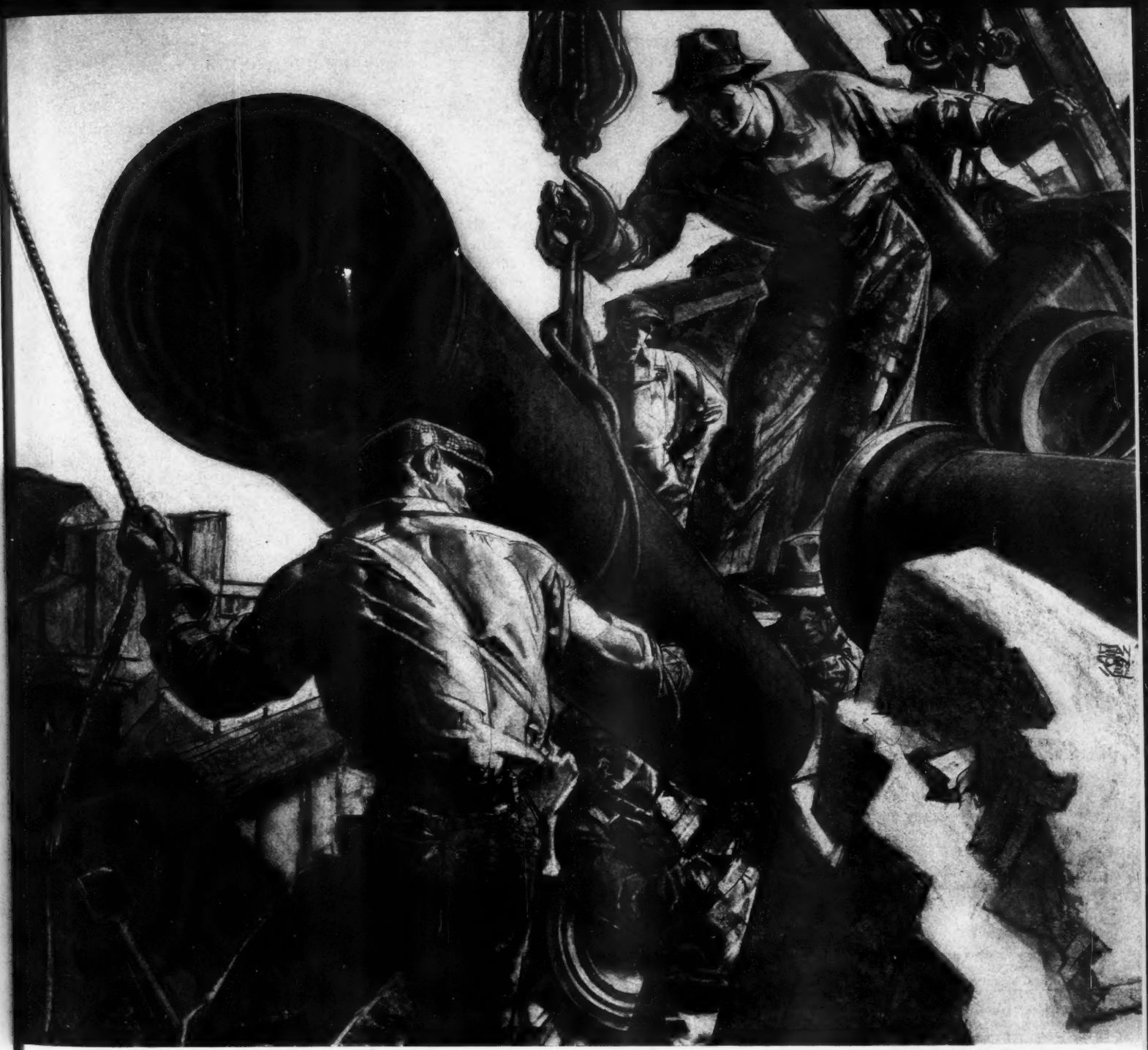
### Sewer Infiltration Checked With Bentonite

Used in laying new sewers, a ½" coat of bentonite is placed around the outside of a joint and held in place by a strip of burlap until backfilling is in place; this insures against infiltration, even with a carelessly made joint. In one case of an 8" existing sewer 10 ft. deep, infiltration was stopped by pumping a 4% solution down to it through a 1" pipe; cost about 5 cts. a foot for material.[H3]




Municipal Sanitation

**Piping arrangement for burning sludge gas and city gas in one burner, at Grass Island plant.**





Hail to the Forties! We greet the new decade and report on progress in the decade which has passed. During the Thirties this Company developed and patented the Super-deLavaud process of casting gray iron centrifugally in a metal mold without chill—erected and equipped a headquarters research laboratory at Burlington—completed a broad modernization program with augmented facilities for centrifugal casting at Bessemer and Birmingham, and an extension and improvement of our plant at Chattanooga, particularly for the manufacture of fittings and special castings. We begin our fifth decade better than ever equipped for service.

# U.S. cast iron PIPE

*for water works, gas, sewerage, drainage and industrial services.*

**U. S. PIPE AND FOUNDRY CO. General Offices: Burlington, N. J.**

Plants and Sales Offices Throughout the U. S. A.

### Treating Packinghouse Wastes At Austin, Minn.

The Hormel Co., at Austin, kills 2,000,000 lb. of animals a day. The wastes from this are heavily chlorinated and settled, reducing the B.O.D. from 2,000 to 600-800 ppm and the suspended matter from 1900 to 200 ppm. before discharging into the sewer. (The company is considering treating the sedimentation effluent by high-rate filtration instead of chlorination.) In spite of this, the wastes that the city plant must handle have a population equivalent to 80,000; while the population contributing domestic sewage is only about 18,000. Because of the small diluting stream, the combined sewage must be treated to give an effluent with less than 30 ppm 5-day B.O.D. The plant for this is just going into operation. It consists of screenings grinder; equalizer tank; flocculators; preliminary sedimentation; preliminary high-rate filters; intermediate sedimentation; final filters; final sedimentation; chlorination; two-stage digestion; sludge drying beds. Special attention has been given to permit overcoming strength of sewage progressively rather than in one or two devices, and cutting out any that temporarily are not needed. Chemical coagulants can be used when heavy plant loadings coincide with low stream flow; it is anticipated that these and chlorination will be required about 30 days during the year. Secondary filtration can be omitted during high water. It is expected that, with a raw sewage B.O.D. of 480, flocculation and sedimentation will remove 35%, preliminary filtration and sedimentation 55%, and final filtration and sedimentation 75 to 80%.[C12]

### Bulking of Activated Sludge

The addition of carbohydrates to sewage causes rapid and severe bulking of activated sludge; but in plant operation, bulking generally occurs in the absence of appreciable quantities of carbohydrates, except where these are contributed by brewery or other wastes. This paper, describing studies made at the New Jersey Agricultural Experiment Station, deals only with bulking caused by carbohydrates. Conclusions reached, stated briefly, were as follows: Bulking induced by the addition of glucose or starch to activated sludge did not result in a higher fat content of sludge, nor were fine particles of floc in the effluent higher in fat content than the settled sludge. Addition of sufficient available nitrogenous material retarded bulking, the optimum amount being that which will permit the rapid utilization of glucose and leave a slight excess for nitrification, which amount, expressed as the C-N ratio of sugar and nitrogenous material, is approximately 8. With little glucose added there is little increase in sludge index; but as the amount of glucose is increased, rapidity and violence of bulking increases also. The higher the sludge concentration, the less rapid and violent the bulking. There is a definite sugar-sludge ratio for maximum sludge bulking. The condition of the sludge is important—with a given sugar and nitrogenous dosage, a highly nitrified sludge will bulk less readily than if in a less nitrified condition. If the amount of urea added exceeds the nitrogen requirements set up by the glucose, adding glucose up to 600 ppm has little effect on rate of nitrification of the urea. Inoculation of non-bulky sludge with a small quantity of bulky sludge accelerates rate of bulking if the sludge is dosed with glucose, but if dosed with sewage the sludge index is unaltered. Bulking produced by carbohydrates is a direct response of sphaerotilus (a facultative anaerobe) to a relatively long contact with an available energy food. Zoogleal organisms (strict aerobes) cannot be made to bulk under conditions which readily induce sludge bulking.[C1]

### Effect of Temperature On Oxygen Utilization

The influence of temperature upon the rate of oxygen utilization by activated sludge and sludge-sewage mixtures was found to be fairly uniform under both summer and winter operating conditions; this influence being represented by the formula $y=0.71 \times ^{1.54}$, in which y is the relative activity in percent based on the value at 25° C taken as 100%, and x is the temperature in degrees Centigrade. The influence of temperature with activated sludge was the same, whether or not nitrification occurred, and was the same for both nitrogenous and carbonaceous oxidation. The character of the oxygen utilization rate curves when oxidizing sewage varied with the seasons, this variation being correlated with loss of ability to oxidize nitrogen during the winter months. Winter sludges used more oxygen at a given temperature than the corresponding summer sludges; which variation has been correlated with the compensating ability of activated sludge to overcome, in part, the influence of seasonal temperature changes.[C2]

### Effect of Digestion On Methane-Producing Bacteria

Laboratory investigation indicated that septicization of fresh sewage solids results in the bacterial production of growth-inhibitory substance inimical to methane organisms; and that there are certain growth-promoting substances in ripe sludge which overcome this action of the inhibitory substance in the septic liquors.[C3]

### Vacuum Filtration At Minneapolis-St. Paul

The Minneapolis-St. Paul treatment plant was placed in operation June 1, 1938, but continuous routine operation did not begin until December. The sludge is pumped from settling tanks to one of two concentration tanks, and after a day or two to conditioning tanks prior to filtration. Raw sludge averaged pH 6.0, moisture 92.16%, volatile solids 63.4%; after concentration, the averages were pH 5.9, moisture 90.64%, volatile solids 62.2%.

The time of sludge conditioning averaged 24 min.; chemicals used, 2.08% (of weight of dry solids) ferric chloride and 4.88% lime. Proper mixing of conditioned sludge is of utmost importance; after trying various methods, low-pressure air (excess from the filter blowers) was applied through 18 small pipes in each tank. The quantity of chemicals required is less with heavy sludge. If sludge contained more than 10 to 12% solids it had to be diluted to permit movement through the piping. Sludge has been held in storage for as long as seven months to determine what effect, if any, this would have on the amount of chemicals required. There was no increase in chemicals required and no appreciable drop in the filter rate, but odors increased.

The sludge cake produced averaged 35.4% solids; daily maximum, 50%. Volatile solids varied from 69.3% to 33.5%. The filters have produced 103.7 tons of dry solids daily, averaging 5.31 lb. per sq. ft. per hr. With high chemical dosages, rates of 10 lb. were obtained; but the additional chemical costs and difficulties with the thicker cake more than offset this increase. The wire screens under the filter cloths became coated with calcium carbonate, which was removed by sand-blasting at a cost of $15 each. At first, filter cloths lasted only 150 hrs., but the life was extended to over 200 hrs. by reducing the lime dosage. Filtering raw sludge produces some odors but not serious enough to justify correction costs. At first, trouble was experienced handling the filter cakes, which came off in blocks the width of the drum and 8 ft. long; which was remedied by fastening to the take-off plates ¼" rods spaced 12" centers, which cut the cake into 12" ribbons.[C4]

### Sludge Incineration At Minneapolis-St. Paul

The three multiple-hearth incinerators, during a 90-day test, met all guarantees. With a nominal capacity of 60 tons of dry solids per 24 hrs. each, they burned as high as 80 tons and averaged 59.1 tons over a 9-month period, evaporated 4.35 tons of moisture per hour per incinerator. They created no fly ash, odor or smoke nuisance. The actual cost of operation was 45.5 cts. per dry ton. (Guaranteed cost, 70.7 cts.) The only fuel oil needed was for bringing cold furnaces up to incinerating temperature and holding temperatures in furnaces out of service—an average of 2.4 gal. per ton of dry solids incinerated. Power required averaged 16.5 kwh per ton of dry solids.

The only real difficulty was the production of too much heat by the sludge. It had been intended to use $2500 of fuel oil a month, keeping the temperature at 1400° to 1600°. But soon after beginning incineration, temperatures up to 2200° were recorded, necessitating replacing several rabble arms and part of the central shaft, discontinuing the use of fuel, and dissipating more than 6,000,000 Btu per hour per incinerator. The combustible content of the ash averaged 1.6%.[C4]



### Sludge Filtration and Incineration at Buffalo

Buffalo, N. Y., has been operating for a year a treatment plant in which the sludge from 600,000 population has been vacuum filtered and incinerated. The sludge pumped from the settling tanks to the digesters averaged 3.46% solids (due to inexperienced operators) but now is running 9 to 10%. Digested sludge averages 12%. Sludge cake av-

erages 38.2% solids, 38.8% volatile; chemicals used averaged 9.25% lime and 2.31% ferric chloride. The incinerators burn 84 tons of cake per furnace per day, using 850 cu. ft. of gas per ton of wet cake.

The filters have handled up to 13.4 lb. dry solids per sq. ft. per hr.; monthly averages above 8 lb. The thick, heavy cake, dropping onto the belt in large pieces, caused irregular delivery; so the cake now drops into a bin, from which it is fed to the belt by a screw conveyor.

The sludge cake contains about 23% sand, which caused rapid abrasion in certain parts of the drying and sludge handling equipment. These parts have been reinforced by welding on hard surfacing, and are replaced at intervals. Grit from the grit chambers is to be screened before feeding it to the incinerator, as coarse material in it causes trouble in the drying and sludge handling equipment.

In pumping raw sludge through 600 ft. of 10″ c.i. pipe, the pipe became almost filled with grease, causing the pumping head to rise from a normal of 20 to 30 lb. to 50 and even 60 lb. when pumping at high rates. This grease was flushed out with steam and hot water.[C5]

## Garbage Disposal With Sewage at Gary

Gary, Ind., is building a sewage treatment plant to handle 150 mgd by sedimentation and sludge digestion, estimated to cost $1,715,543. The engineers of the Board recommend that, in addition, the city's garbage be ground and mixed with the sewage, and that three additional digesters (6 are provided for the sewage) be provided to handle the increase. The total additional cost is estimated at $175,000. It is estimated that the additional gas obained by digesion of the garbage would be worth $13,000 to $19,500 in terms of equivalent power that must otherwise be purchased.[C6]

## Dewatering Sulphur Dye Activated Sludge

Sulphur dye-sewage waste can be treated successfully by the activated sludge process, but dewatering is more difficult than that of sludge from sewage alone, requiring approximately twice as much ferric chloride. Better results were obtained in dewatering fresh sludge than that which had been stored overnight.[C11]

## Outfall Sewer Construction

For subaqueous outfall sewers, pipes are generally preferred to tunnels or cofferdam construction, especially beyond the surf line in the ocean. For less than 18″ diameter, all-metal pipe is generally used. For larger sizes, cast iron or concrete is customary, reinforced concrete having been used up to 96″. Protective coating of pipe does not seem practicable where the pipe is dragged into place, but can be used where they are lowered directly to position.[E1] Where the pipe is smaller than 18″, shotcrete over wire mesh, covering joints and all, is an advantage both as protection and giving desirable additional weight.

Joints are the most vulnerable part of an outlet. Bell and spigot or ball and socket are customary for large pipe. Cast iron ball and socket joints have been used in a 60″ concrete pipe. The fewer the joints the better. About 14 to 16 ft. is the practical limit for length of concrete pipe. (A 5-ft. pipe weighs about a ton per lineal foot.) Flexible joints should be provided at intervals of 5 to 10 sections. Joints made on the bottom in place are preferably calked from the inside. If plastic jointing material is used it should be such as will not be softened by warm sewage.

Multiple outlets may be effected by use of wyes, openings in the top of the pipe, or both. Addition of diffuser caps increases dispersion. Above the zone where the waves break, the best protection is obtained by laying the pipe in a rock trench covered with concrete. Beyond this, laying on the surface is best if this is not too irregular; if irregular, a trestle may be used but this offers more danger of collisions and movement by cross currents. Timber trestles are preferable to steel. Pipe on the bottom may be anchored by concrete piers; or by large chains fastened to the pipe and carried 25 ft. from it on each side, which soon settle into the sand.[E2]

Costs have ranged from 35 cents to $2.50 per lineal foot per inch diameter. Sizes from 6″ to 144″. Cast iron has been used for sizes up to 84″; concrete for sizes 42″ and larger; wrought iron and steel for all sizes up to 60″. Lengths of outfall run generally from 1,000 ft. to 7,000 ft.; one is 25,600 ft. long.[E6]

## Centrifugal Sewage Pumps

If pump is submerged, bearings and other parts needing attention are inaccessible without removing the pump, and then overhauling is offensive work. Vertical shaft pumps in dry pits are generally more costly than horizontal, for motor, suction intake and foundations cost more, and the casing is special. Priming equipment must be provided for a horizontal pump, but the cost of this is less than the costs named above.[G1]

## *Bibliography of Sewerage Literature*

***The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.***

*c.* Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

**C** *Sewage Works Journal*
*November*

1. t. Bulking of Sludge by Means of Carbohydrates. By R. S. Ingols and H. Heukelekian. Pp. 927-945.
2. t. Influence of Temperature Upon the Rate of Oxygen Utilization by Activated Sludges. By C. N. Sawyer and G. A. Rohlich. Pp. 946-964.
3. Growth of Methane-Producing Organisms in Supernatant Sludge Liquors. By H. Heukelekian and B. Heinemann. Pp. 965-970.
4. Sludge Disposal at the Minneapolis-St. Paul Plant. By G. J. Schroepfer. Pp. 971-987.
5. Filtration and Incineration at Buffalo. By C. R. Velzy. Pp. 988-993.
6. Sewage Treatment at Gary. By L. R. Howson. Pp. 994-1005.
7. Development of Flash Drying System of Sewage Sludge Disposal at the Sanitary District of Chicago. By W. A. Dundas. Pp. 1006-1019.
   Operating Problems in Starting the Southwest Plant of the Sanitary District of Chicago: (See 8, 9 and 10 below).
8. Treatment Problems. By C. J. Mickle. Pp. 1020-1025.
9. Chemical Control. By G. G. Poindexter. Pp. 1025-1029.
10. Mechanical Organization. By R. C. Hageman. Pp. 1030-1037.
11. Dewatering of Activated Sludge Obtained by Treatment of a Sulfur Dye-Sewage Mixture. By R. Porges and H. J. Miles. Pp. 1038-1044.
12. Packinghouse Wastes and Sewage Treatment at Austin, Minn. By P. Hansen and K. V. Hill. Pp. 1045-1053.
13. Fine Screening of Sewage. By J. A. Muldoon. Pp. 1054-1066.
14. "Joint Meeting" (N. J.) Sewage Disposal Plant: Excerpts from Annual Report for 1938. Pp. 1067-1074.
15. Sludge Gas Engine Operation at Michigan City, Ind. By H. H. Jones. Pp. 1074-1077.
16. Excerpts from Minneapolis-St. Paul Sanitary Dist.'s 1938 Report. Pp. 1078-1083.
17. Excerpts from First Annual Report of Buffalo Sewer Authority. By C. R. Velzy. Pp. 1083-1088.

**D** *The Surveyor*
*November 24*

1. p. Progress in Sewage Purification. By H. C. Whitehead. P. 442.
2. p. Recent Experiments on Activated Sludge. Discussion. Pp. 445-446.

*December 1*

3. p. Rivers Pollution Prevention as a Public Health Service. By F. Wrigley. Pp. 459-460.

**E** *Engineering News-Record*
*November 23*

1. The City's Sewage Goes to Sea. By. N. A. Bowers. Pp. 49-51.

*December 7*

2. The City's Sewage Goes to Sea. II. By N. A. Bowers. Pp. 82-84.
3. Stream Pollution Legislation: Present Status. Pp. 93-94.
4. Notes on Sewage Disposal. By W. Rudolfs. P. 96.

*December 21*

5. Power From Sludge Gas at Albuquerque. By W. W. Wheeler. Pp. 64-65.
6. The City's Sewage Goes to Sea. III. By N. A. Bowers. Pp. 68-70.

**G** *Water Works & Sewerage*
*December*

1. Priming Centrifugal Sewage Pumps. By H. V. Petersen. Pp. 481-483.
2. Vacuum Filter Dressing Rig. By W. D. Sheets. Pp. 490-491.
3. Determination of Hydrogen Sulphide. By G. Martin. P. 501.
4. Venturi Meters for Sewage and Sludge. By C. G. Richardson. Pp. 502-505.
5. Runoff Coefficients by Model Tests. By I. Gutmann. Pp. 506-508.

**H** *Municipal Sanitation*
*December*

1. Sludge Filtration Controlled by Automatic pH Recording. By A. J. Beck and L. M. Johnson. Pp. 582-584.
2. Boiler Burns Sludge Gas and City Gas Simultaneously. By G. E. Griffin. Pp. 585-586.
3. c. Sewer Infiltration Checked by Use of Bentonite. By E. C. Hallock. P. 586.

J *American City*
*December*

1. New Water Softening Plant. (Elkhorn, Wis.). Pp. 45, 73.
2. Power from Sewage Sludge Gas: An Economy Measure. Pp. 50-51, 73.
3. p. Charges for Sewer Service. By L. A. Bouyea. P. 62.

P *PUBLIC WORKS*
*December*

1. Grease Flotation Features Sewage Treatment Plant at Bellefontaine, O. By F. G. Browne. Pp. 9-11.
2. p. Methods and Results of Activated Sludge Treatment of Dairy Wastes. By S. D. Montagna. Pp. 27-28.
3. n. Life Cycle of Trickling Filter Flies. P. 28.
4. Practices in Sewer Construction in Wet Ground. P. 32.
5. n. Using Sludge Gas as Vehicle Fuel. P. 26.

## Collection of Water Rates

The Illinois Appellate Court holds, Town of Cicero v. Township High School Dist. No. 201, 20 N. E. 2d 114, that when a municipality establishes a system of waterworks, its rates and charges to those who use the water are imposed and collected, not as a tax, but as compensation for a commodity used. The contractual relation between the municipality and the consumer does not give the municipality the authority to collect these charges as delinquent charges under the revenue law. The statute does give a lien upon the consumer's real estate for the charges, which may be enforced.

## Damages for Sewage Pollution

The New York Appellate Division holds, Squaw Island Freight Terminal Co. v. City of Buffalo, 11 N. Y. S. 2d 459, that where the damage to the owner of an island in the Niagara river by sewage from defendant city polluting the uplands of plaintiff's property would cease on a certain date because of the construction of a sewage disposal plant by the city, the damages recoverable therefor would be the depreciation in rental value of the island up to that date, with interest upon each annual aggregate of damage.

## Rescission of Contract for Nonpayment of Progress Payments

The contract for construction of a water supply tunnel for a municipality provided that the contractor could terminate the contract and recover for work done and loss sustained and reasonable profits and damages if any progress payments were not made in accordance with the contract. The contractor sued the city, not on this clause of the contract, but for breach of the contract and for damages in rescission. The Federal District Court for Eastern Pennsylvania held, Rae v. City of Reading, 24 F. Supp. 566, that the contractor could recover damages upon showing that he was entitled to rescind by reason of the defendant's default. Rescission was based on misrepresentations as to character of subsoil through which the tunnel was to be driven. The contractor encountered unexpected difficulty. The jury found that the plaintiff rescinded the contract, not only on this ground but also on the ground of failure to make a monthly progress payment as required by the contract. The jury adopting the plaintiff's view of the case, the court held rescission was justified upon the latter ground irrespective of any termination clause contained in the contract.

## "Safe Place" Statute

In an action by a pedestrian against a paving company for injuries sustained when a plank placed between the curb and street car tracks cracked under plaintiff's weight, the evidence was held insufficient to allow the jury to find for plaintiff, there being no evidence that defendant set out the plank or that in the exercise of ordinary care it should have known the plank was in the street. There was no violation of the Wisconsin safe place statute, under which it is the rule that an employer is not liable unless he has actual or constructive notice of a condition of maintenance that renders a place of work unsafe.

# The Waterworks Digest

**Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.**

### Broad-Crested Weirs As Measuring Devices

Using the pressure-momentum theory as a basis, the authors have developed formulas for using broad-crested weirs as a measuring device, in which the coefficient is constant for all heads, and only the measurement of the head on the weir is needed. "The accuracy of the formulas is to be questioned if the breadth of the weir crest is so small that the water surface does not become parallel to the surface of the weir, or nearly so." Checked against a standard sharp-crested weir with heads varying from 0.068 ft. to 0.588 ft., results varied from 0 to ± 4.7%, 60% of the variations being less than 1%.[K2]

### Removing Mud Balls From Filters

The Springwells filtration plant, Detroit, Mich., with a rated capacity of 272 mgd is the second largest in the world. After 3 or 4 years' use, with 50% sand expansion wash, mud balls were found to have formed throughout the sand. After trying other methods for eliminating these, three ejectors were made from standard pipe fittings, with 3″ discharge pipe and 1½″ hose connection to a ¾″ nozzle. When it is desired to clean a filter (usually twice a year) these three ejectors are set with their vertical suctions about 2″ above normal sand level; wash water is applied to expand the sand 2″ (10%), which brings all mud balls to the surface, where they are drawn into the ejector and expelled into the wash water so well broken up as to be carried off by it. Three ejectors working in a filter of 1089 sq. ft. area thoroughly clean it in about 4 hrs.; placing and connecting up the ejectors requires about 1 hr.; about 3 m.g. of wash water and 50,000 gal. of ejector water are used.[F3]

### Washing Filter Sand at Ft. Wayne

Ft. Wayne, Ind., has ten rapid filters of 2.4 mgd capacity, containing 30″ depth of 0.48 m m sand. Wash water rates vary from 15″ to 30″ rise per min., 25% to 40% expansion. Sand volume increased during use, principally by accumulation of lime and carbon deposited at the plane between sand and gravel. Accumulation of calcium carbonate on the sand grains increased their size 11%. To return the filter to its original condition, the sand was discharged by eductor from filter to a vibrating screen (such as is used in the mining industry) and the oversize particles screened out and hauled away; water jets directed normal to the screen facilitated the screening. After removing the sand, the gravel was loosened with a spade, and washed with filter wash at a 30″ to 42″ per min. rise, which removed carbon and fine particles of lime that had penetrated into the gravel.[F1]

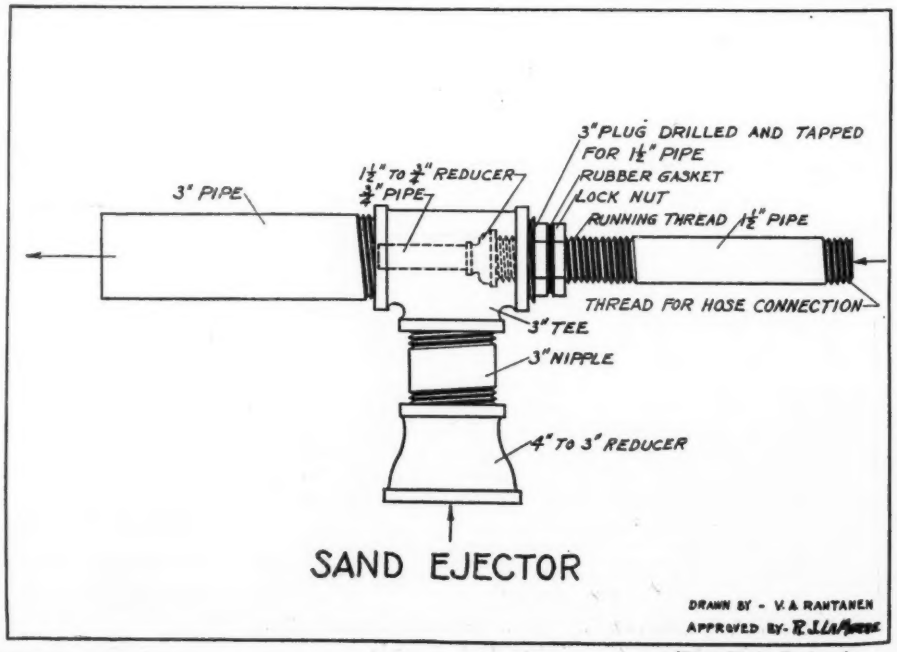
### Chicago's First Filtration Plant

Construction is under way on Chicago's first filtration plant, designed to treat 320 mgd, to serve 2,000,000 population in 1960 (Present population of the area served, 1,387,000). The plant will cover about 38 acres of made land in the lake, an additional 115 acres of park and beach being included in the project; also 2 miles of 16 ft. tunnel in rock, bringing water from inlet crib to plant and thence to the existing tunnel system. Estimated ultimate cost, $20,000,000. After completion of the filters, 50,000 meters are to be installed.

The filter is designed to operate at a maximum rate of 2.5 gpm per sq. ft. in winter and 3.0 in summer, using acid-treated sodium silicate to strengthen the coagulation when the floc otherwise would not be strong enough. Time of mixing after addition of coagulant, 45 min.—22 to 25 min. for peak-hour demand should this reach a 4-gal. rate. Settling time, 4 hr. for yearly average, 2 hr. at peak rate. The sedimentation tanks are two-story, each story 16 ft. deep. The 80 filter beds are 54 x 26 ft. Ordinarily the water level will be 7.5 to 8.5 ft. above the sand. A surface wash system will be provided.[E1]

### Double Filtration At Lawrence, Mass.

The old covered slow sand filters of Lawrence, Mass., have been largely replaced with rapid sand filters and chlorination, although the former are retained unchanged with the idea that the effluent from the latter may be passed through them "to insure the production of a uniformly safe supply." But so far "Prechlorination and rapid sand filtration have been adequate to produce effluent of satisfactory bacte-




Water Works Engineering

**Sand ejector used for removing mud balls from Detroit filters.**

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

rial quality." There are ten 1 mgd rapid filter units, each 18 x 20.3 ft., containing 18″ of gravel supporting 33″ of sand. It is proposed eventually, after repeated washings have brought any excessively fine material, shell, etc. to the top, to remove the top 3″. The sand has an effective size of 0.46 m m and a uniformity coefficient of about 1.9. Surface washing is provided for by nozzles spaced 3 ft. apart in each direction, about 4″ above the ultimate sand surface; each nozzle directing one ¼″ jet straight down and four others at 38° below the horizontal. Taste and odor removal is an important function, and the effluent from the rapid filters can be passed through a low-head spray aerator consisting of 70 nozzles operating under a 4 ft. head. The concrete floor receiving the nozzle sprays is surrounded with a fence of corrugated asbestos-cement boards to prevent spray loss.[E5]

### Filter Underdrains Of Porous Plates

Use of porous plates of coarse structure instead of pipe manifolds and gravel is claimed to decrease the cost by that of the gravel; to lower the operating head when filtering and when backwashing; eliminate many operation troubles and decrease servicing; give longer runs with less washwater consumption; permit greater depth of anthracite medium without increasing depth of filter box. Three or four years' experience indicates there is little danger of clogging. Accumulation of alum floc on the plates is readily removed by a 2% solution of caustic.[X6]

### Agitation in Filter Washing

The Palmer "filter sweep" (described in Waterworks Digest for November 1938) is more appropriately called "filter bed agitator." Proper designing involves determination of number of nozzles per sq. ft. of filter area, nozzle pressure and apereture size, and what angle from the horizontal. Benefits claimed are continuous cleanliness of filters, saving in washwater and operating expense. With cleanliness, rates can be increased and more turbid water handled. Wash water rates are reduced, reducing effect of improperly designed filter bottoms. Growth of organic and inorganic incrustations can be avoided. Clogging of filters by use of carbon had given trouble at Beaver Falls, Pa., but it has been entirely eliminated during 4 months' operation of the agitators. A company by installing an agitator and using anthrafilt increased filter capacity from 2 gpm. per sq. ft. to 4 gpm. and get 50% longer runs.[X7]

"The date of discarding of agitation is the date of the birth of mud balls." Even if the filter bottom, washwater troughs, freeboard, depth and size of filter medium were all perfect, "I still doubt that it could be washed clean with washwater applied from below only." Excessive freeboard is the worst offender. The 2-gallon rate is really a 4-gallon rate through the clean sand, less through that imperfectly cleaned; with complete cleaning obtained with agitation, a 4-gallon rate is possbile throughout the bed; Fuller obtained a high-quality effluent at 6 gallons using mechanical rakes.[X8]

### Leak Detection In Dallas, Tex.

Using a leak detector, the maintenance crew of the Dallas Water Dept. during six months tested 235 miles of mains and 1300 fire hydrants, finding 108 joint leaks on mains, 92 leaking hydrants and 64 leaking services, estimated to be leaking about 1.425 mgd. The cost was $834.35 for labor, $35 for maps, and $316.05 for upkeep and depreciation of the instrument and transportation; an average of $5.04 a mile. While learning to use the instrument, the operators turned in 45 false alarms out of the first 309, but the percentage of errors later dropped to less than 4. Leak variations carry farther on small mains than on large; half a block or more on 12″, but less distance on larger mains.[X11]

### Leakage in Cast Iron Pipe Joints

Forty miles of 6″ to 36″ cast iron pipe in Chicago laid recently, tested for 24 hrs., showed leakage of 6 to 17 gimd. (AWWA specifications permit 75). Joints were lead calked with air hammers. In Lincoln, Neb., 25 miles of 36″ C.I. pipe showed 11.2 gimd. and 25.2 after two years of use. In Kenosha, Wis., of 16.4% of water unaccounted for, only 0.3% was leaks in mains, 2.3% were leaks in services and 4.2% were losses through large meters. In 7 other Wisconsin cities, leakage surveys revealed 5.2% leakage in services, 4.5% in meters, and 1.3% in mains.[X12]

### Protection of Pipe From Corrosion

It has been estimated that 90% of all pipe line footage in the United States lies in soils not extremely corrosive; hence many good records of protective coatings are due to the fact that the soils are not seriously destructive rather than to the good qualities of the coatings. There is a much greater loss to the water works industry due to graphitic corrosion than is generally realized. The present specifications for coating on cast iron pipe as set up by the A.W.W.A. do not insure getting a coating of corrosion protective value.[X14]

In El Paso, Tex., 30% of the area has soil corrosive to cast iron and steel. In such areas the pipe is surrounded with a 6″ mixture of sand and lime, 8 or 10 parts to 1 by volume; the sand to prevent direct contact of the soil with the pipe, the lime to neutralize the acid in the soil.[X16]

### Cement Joints For Cast Iron Pipe

El Paso, Tex., has used cement for joints of cast iron pipe for 8 years with very satisfactory results. Material and labor costs are low, and the joints seem to be more durable than lead or sulphur compounds. Results have been exceptionally good under conditions of live load, impact and vibration, and uniformly satisfactory under dry, damp and wet soil conditions. "So far, we have not noticed any signs of disintegration of this material and the number of failures of all kinds and under all service conditions during a period of approximately 8 years could well be counted on the fingers of two hands."[X16]

### Removing Color and Manganese With Iron Salts

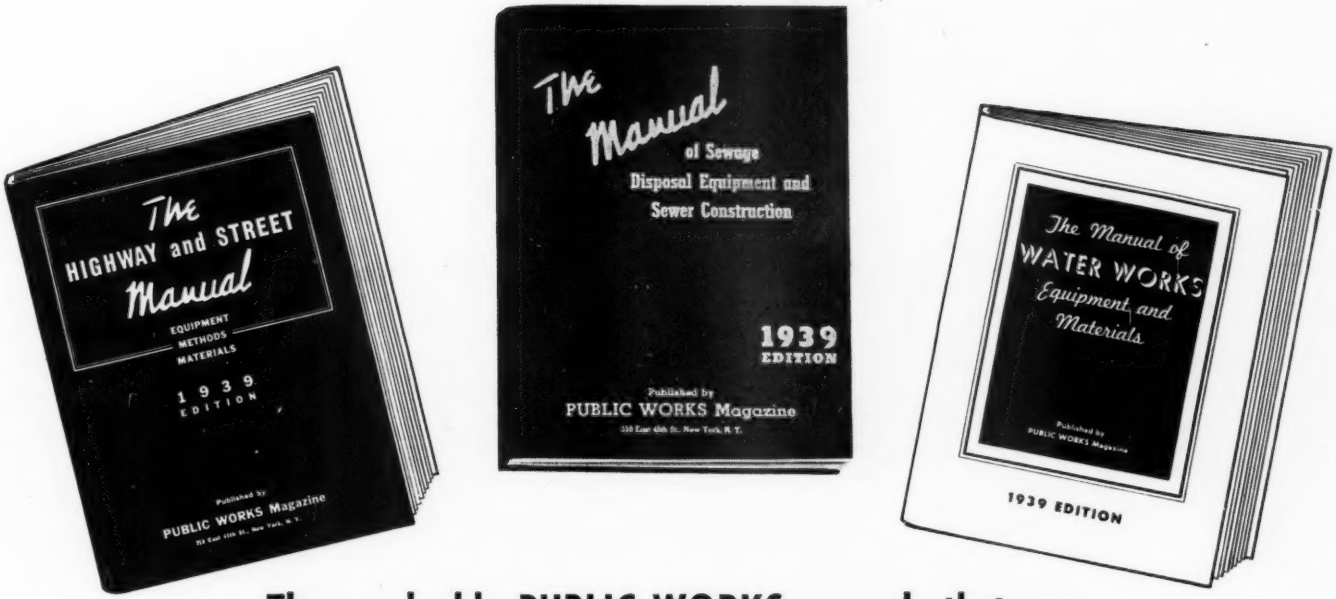
At Albany, N. Y., soft water (under 50 ppm.) containing 3.30 to 0.02 ppm. of manganese was treated by the lime and iron process, and with ferric sulphate. Both removed manganese at a pH of 9.0 to 9.5; but with the former, residual iron in the effluent imparts a slight but bitter taste to the water; with the latter the effluent is very low in color and residual iron. In both, colloidal organic matter brought into suspension by the fall turnover seriously interferes with the efficiency of the process. Due to the low manganese removal effected by the basins (43%), the filter sand becomes heavily coated with manganous oxides, making it possible to adsorb 65% of the manganese in the raw water during the winter period of coagulation although using a very low dose of alum.[A134]

### New Type of Water Tank at Indianapolis

Recently placed in service at Indianapolis, Ind., is a 1.5 mg water tank, spheroidal, with a Horton radial cone bottom, supported on 16 plain steel tubes 54″ in diameter, 12 of them equally spaced on a 78 ft. diameter circle, the other 4 on a 15 ft. diameter.

# WHAT IS AVAILABLE? WHAT IS NEW?

# WHERE CAN I GET IT?




## Three valuable PUBLIC WORKS manuals that are

## A GREAT HELP

**in working up data on Highways and Streets, Water Works, and Sewerage and Sewage Disposal.**

## *COMING AGAIN IN 1940—REVISED, ENLARGED, IMPROVED*

THESE are handy working MANUALS of equipment, materials and methods in the highway, sewerage and water works field that every engineer, superintendent and sales representative will find a tremendous help.

The MANUALS tell what products are available for your use, what each product is intended to do, and discuss the most approved practices to be followed in each step of design, construction and operation. Considered indispensable in over 10,000 engineering offices because they condense a whole library into three handy, helpful volumes.

Text matter is fully illustrated, and supplemented by informative advertising of the leading manufacturers in each branch of the industry. Advertising and text pages are placed opposite each other in chapters for easy reference and to form a complete coherent story.

Not catalogs, indexes or directories in the ordinary sense, but up-to-date, organized MANUALS of newest products and practices, invaluable to every highway, sewerage and water works engineer and official. If you don't have copies of these useful MANUALS, write asking how to obtain the last edition. Published by

**PUBLIC WORKS Magazine**
**310 EAST 45th STREET, NEW YORK, N. Y.**
**Engineering . . . Construction . . . Maintenance . . . Operation**

### WHAT USERS SAY ABOUT THE MANUALS

"The Manuals are invaluable in discussing the necessities of a plant with a non-technical group, and most convenient for superintendents and engineers as time savers in comparing the various products available."—*City Engr.*

"Your Manual is used in connection with every sewage disposal project that we lay out."—*Consulting Engr.*

"I use it daily, and find the working data with each item of equipment of great value in estimating the work that can be expected from such equipment."—*County Engr.*

"We use the Highway and Street Manual almost every day."—*Equipment Dealer.*

**WATCH FOR THE NEW, REVISED 1940 MANUALS WHICH WILL BE OUT LATER THIS YEAR.**

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

There is no central riser, one of the four inner columns serving as such. Another of these columns gives access to the tank, having a door at the bottom, a ladder inside, and extending above water level; a stairway above it leading to a hatch in the roof; while a 12″ overflow pipe passes down through it. The control house, underground under the center of the tank, contains an hydraulically operated cone-plug altitude valve to control the water level. Rusting is prevented by "cathodic protection."[G44]

### The Highest Large Tank

Batavia, N. Y., last year completed the highest tank yet constructed of equal capacity (1.5 million gallons) or greater, the height to the water line being 169 ft. and water depth 25 ft. (Two 2 m.g. tanks have been built, with heights to water line of 125 and 102 ft. respectively; five 1.5 m.g. tanks have been built, the other four having heights of 167, 158, 140 and 129 ft. to high water line; and fifteen 1 m.g. tanks with heights from 174 to 125 ft.)

This tank is supported by 28 columns in two circles of 14 each. Levels on the foundations taken before filling the tank and 12 hrs. after filling it (weight of water, 13 million lb.) showed settlements from zero at 5 footings to a maximum of 0.02 ft. at one; no further settlement for 4 months thereafter.[E2]

### Chile's Water Works

The Republic of Chile has a population of about 4½ million, of which 49% lives in villages of more than 1,000 population. Since Feb. 12, 1906, the state government has been in charge of all water and sanitary works in the country. Every city of over 5,000 has a public water supply, and every one over 10,000 has a sewerage system. Only 10 of those over 2,000 have no water supply, and 52 smaller villages have such supply. All together, 89.8% of the urban population has water supply works, and 75.7% has sewerage. These public services are grouped in provincial nuclei, each under an expert sanitary engineer. Six bacteriological and chemical laboratories are distributed throughout the country to control the quality of the water supplies, testing each supply in their respective districts every week. In the 96 water supply systems 87% of the services are metered, 8 supplies are treated with rapid filtration and chlorine, 7 with slow filtration and chlorine, 2 with sedimentation and chlorine, 56 chlorinated only; 23 use untreated water. Four cities have sewage treatment plants.[A8]

### *Bibliography of Waterworks Literature*

***The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.***

*c.* Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
*November*

1. t. Methods of Calculating Water-Hammer Pressures. By F. M. Dawson and A. A. Kalinske. Pp. 1835-1864.
2. t. Pressure Air Chambers in Centrifugal Pumping. By W. L. Boerendans. Pp. 1865-1892.
3. Water Hammer Studies on Long Pipe Lines. By L. E. Goit. Pp. 1893-1903.
4. Water Hammer Control by Proper Valve Installation. By E. C. Brisbane. Pp. 1904-1908.
5. t. The Correlation Between Carbon Dioxide and Mineral Content of Water and Its Corrosivity. By W. Rudolfs and T. T. Wong. Pp. 1909-1925.
6. New Knowledge of Fluorine in Relation to Dental Caries. By G. J. Cox. Pp. 1926-1930.
7. A Uniform Basis for Activated Carbon Comparison. By W. A. Helbig. Pp. 1931-1944.
8. Water and Sewage Works in Chile. By L. Lira. Pp. 1949-1956.
9. Joint Administration and Collection of Water and Sewer Accounts. Committee report. Pp. 1957-1963.
10. Experiences in Establishing Sewer Rental Charges. By F. O. Wallene. Pp. 1964-1969.
11. Licensing Water Works Employees. Staff report. Pp. 1970-1974.

E *Engineering News-Record*
*November 23*
1. Filtered Water for Chicago. By L. D. Gayton. Pp. 42-45.
2. High Distribution Tank of Large Capacity. (At Batavia, N. Y.) By A. Potter and M. H. Klegerman. Pp. 60-62.

*December 7*
3. c. Difficult Underwater Piping. By E. B. Myott. Pp. 64-67.
4. c. Pipe Laying Record at Little Rock. Pp. 89-90.

*December 21*
5. Double Filtration Guarantees Good Water. (Lawrence, Mass.) Pp. 50-51.

F *Water Works Engineering*
*November 22*
1. Filter Plant Experiences. (At Ft. Wayne, Ind.) By L. R. Mathews. Pp. 1484-1485.
2. War: Its Probable Effect on Water Companies. By C. Haydock. Pp. 1486-1488.

*December 6*
3. Cleaning Sand at the Springwells (Detroit) Filter Plant. By R. J. LaMarre. Pp. 1538-1540.
4. Pipes in Place Lined with Cement at Charleston, S. C. Pp. 1546-1548.

G *Water Works & Sewerage*
*December*
1. Durham (N. C.) New Tank Largest in the State. By D. Becker. P. 489.
2. Free Ammonia in the Presence of Chloramine. By E. E. Wolfe. Pp. 509-511.

J *American City*
*December*
1. Improvements at Albert Lea, Minn. Pp. 54-55.
2. Water Rates and Service Charges. Pp. 75, 77, 79, 81.

K *Proceedings, Am. Soc. of Civil Engineers*
*December*
1. Analysis of Legal Concepts of Subflow and Percolating Waters. By C. F. Tolman and A. C. Stipp. Pp. 1687-1706.
2. Pressure-Momentum Theory Applied to the Broad-Crested Weir. By H. A. Doeringsfeld and C. L. Barker. Pp. 1719-1731.

L *Civil Engineering*
*December*
1. Sanitary Aspects of the San Francisco Water System. By G. E. Arnold. Pp. 722-723.

M *Canadian Engineer*
*December 8*
1. Submerged Suction Priming System. Pp. 11-12.

P *PUBLIC WORKS*
*December*
1. Filtration Plant Visitors. By F. E. Smith. Pp. 14-16.
2. New Filtration Plant for Fort Benning, Ga. By R. B. Johnston. Pp. 20-22.
3. p. Dry Ice Used for Developing Well at Glendale, Ariz. P. 28.

W *Johnson National Drillers Journal*
*November-December*
1. The Conservation of Ground Waters. Pp. 1-6.

X *Proceedings, Texas Water Works and Sewage Short School*
*Year of 1939*
10. Contamination of Water Wells by Salt Water. By P. Livingston. Pp. 28-30.
11. Leak Detection and Leak Surveys. By K. F. Hoefle. Pp. 31-33.
12. Discussion of Water Main Leakage. By D. W. Johnson. Pp. 34-37.
13. Experiences with Services. By D. W. Robinson. Pp. 37-39.
14. Pipe Corrosion and How It May Be Overcome by Specifications. By S. C. Clark. Pp. 39-41.
15. Prevention of Water Pipe Corrosion with Cathodic Protection. By S. Thayer. Pp. 42-43.
16. Experiences with Various Kinds of Pipe and Joining Material. By A. G. Classen. Pp. 43-47.
17. The Annual Report of the Water Department of a Large City. By H. M. Robinson. Pp. 47-50.
18. Combined Light, Water and Sewerage Works as a Municipal Utility. By R. E. Ward. Pp. 50-55.
19. Water Department Maps and Records. By W. K. Van Zandt. Pp. 55-57.
20. Maps and Records. By A. R. Davis. Pp. 57-60.
21. Arriving at the Cost of Water and Water Service. By S. R. Wright. Pp. 60-63.
22. Control of Large Water Vegetation. By W. F. Hicks. P. 64.
23. Control of Bottled Water. By C. C. Hays. P. 65.
24. c. Construction Methods for Water Wells. By E. A. Vaubel. Pp. 66-70.

## Liability for Engineers' Services

In an action tried by the court without a jury upon stipulations and an agreed statement of facts, to recover for services rendered by the plaintiffs, as civil engineers, in making surveys, plans and specifications, etc., for a proposed improved water-works system owned by the defendant city, the Illinois Appellate Court held, Charles Deleuw, & Co. v. City of Charleston, 298 Ill. App. 403, 10 N. E. 2d 207, that the annual appropriation ordinance of the city containing an item "for water works fund" was sufficiently definite to authorize the expenditure of the services rendered by plaintiffs. It was also held, in accordance with prior decisions of courts of the state, that where an individual undertakes a municipal improvement, agreeing to look to a special fund to be created therefor, and thereafter the city abandons the proposed improvement, the municipality cannot avoid payment by setting up the contingent nature of the contract, but is liable out of the general fund.



When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

# Efficient Equipment and New Devices Feature Road Show Exhibits

BRIEF previews of some of the equipment to be shown at the Road Show to be held at Chicago, Ill., Jan. 29 to Feb. 2 are given below.

*Armco.*—The Armco Drainage Products Ass'n. will exhibit: Pipe arches for drainage where headroom is limited, but hydraulic efficiency important; Sheeting of corrugated metal, which is light but gives adequate strength and is easy to handle and use; Blast plates for protecting overhead structures against locomotive exhaust damage; Tunnel liner plates, both light and heavy duty, for easy and economical tunnel work; and other drainage products.

**Austin-Western "99" Loader**

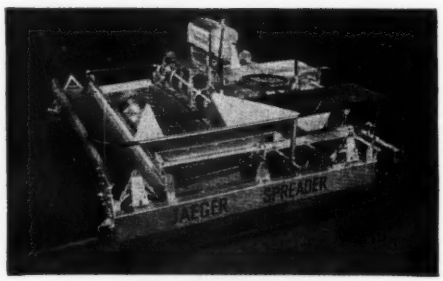
*Austin-Western.*—Among the equipment on display in the Austin-Western booth will be: The "99" loader for trimming down high sod shoulders on paved roads or picking up waste material from roads or ditches and loading it into trucks; the "99" finisher, which can finish slopes of 14 feet or more, with the windrow deposited behind the rear wheels; the improved patrol sweeper with leaf broom; the 4-44 tractor with dual tires and all-wheel drive and steer; an 8-yard scraper of entirely new design; and an improved Cadet roller.

*Barber-Greene.*—Barber-Greene Co. will exhibit a B-G Finisher, mixer, bucket loader and 30-ft. permanent belt conveyor. The mixer on display will be the small one, designed for patching, alleys and tennis courts. Motion pictures and colored photographs of equipment will be shown.

*Allis-Chalmers.*—A new line of high speed diesel crawler tractors, powered by G-M diesel engines will be shown; also a new low-cost grader. The new tractor develops 130 belt horsepower and weighs 27,000 lbs. Speeds 1.72 to 7.0 mph. The new grader is 120-inch wheelbase, 10-ft. board, 31 hp. and 5,960 lbs. Designed for roads, alleys, streets—for ditch to ditch work.

*Jaeger.* — Jaeger Machine Co. will show "revolutionary" advances in equipment for laying both concrete and bituminous pavements. The bituminous paver is equipped with an automatic leveling device to lay to grade lines without forms; a heated screed gives both oscillation and compaction. The "Re-Mixing" concrete spreader (11 are in use on the Penn Turnpike) reworks and spreads at a rate in excess of 100 cu. yds. 1"-1½" slump concrete per hour, allowing a 34-E dual drum paver to work at capacity. The automatic finisher, the latest type Mix-in-Place road builder, an inexpensive windening finisher, new forms pumps and other equipment will also be shown.

*Koehring.*—The Koehring 34-E dual drum paver, finishing equipment, hauling equipment, mixers and mud-jacks; also photographs of equipment in action.




**The Jaeger Spreader**

*U. S. Steel.*—A joint exhibit of U. S. Steel Corp. subsidiaries will show a large-scale model of a cloverleaf, center markings, highway guards, cut-away sections of concrete, reflector signs and posts, etc.

*Mack.* — Mack Trucks will exhibit trucks especially designed for highway construction and maintenance, including a heavy FJ, a cab-over-engine CH equipped with an Etnyre distributor, and an EH with a special body and a snow plow.

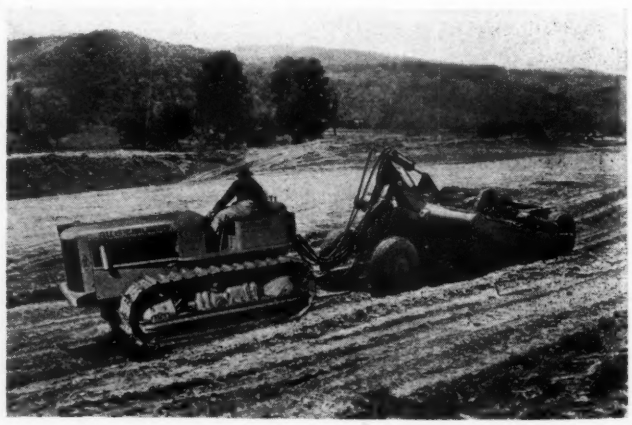
*Bucyrus-Erie.*—B-E equipment will include 2½ and ⅜-yd. shovels, a crane with rock grab, bullgraders, bulldozers, scrapers, dragline buckets and specialties.

*Hercules.*—Hercules Co. will exhibit a model of a standard Hercules roller, complete in every detail, including an Ironeroll, and built to scale. Also a working exhibit of a Hercules roller transmission.

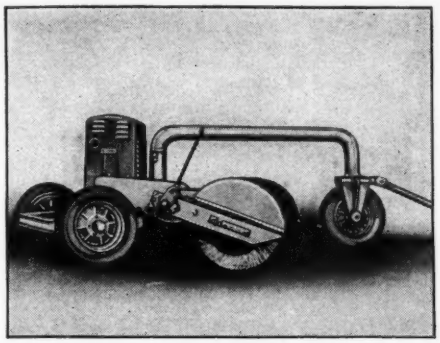
*Link-Belt-Speeder.*—A complete line of power shovels from ⅜ to 2½ cu. yd. capacity.

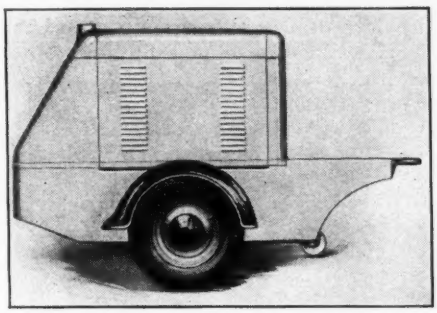
*Solvay.*—Solvay calcium chloride for use in road and plant mix stabilization and surface consolidation; also for making icy roads safe.

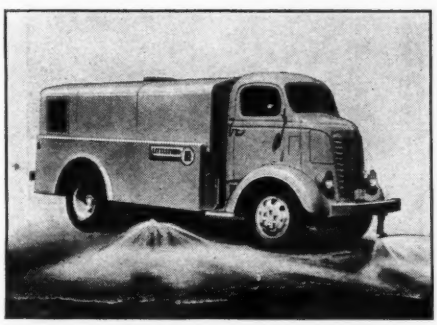
**New Allis-Chalmers motor grader**



**New Allis-Chalmers Tractor**







**Three new Littleford units, top to bottom, road broom, steam generator and street flusher**



*Littleford.*—Littleford Bros. will exhibit a complete line of highway construction and maintenance equipment, both new and improved. New equipment includes the street flusher, the road broom, the steam generator and a pressure distributor. Improved items are the wheeled roller, the bituminous resurfacer, the line marker and the utility spray tank.

*Galion.*—Galion Iron Works & Mfg. Co. will show a new highspeed, self-propelled unit for moving dirt on road, dam and other large scale construction projects. This "Cyclone" unit digs, carries and spreads. Rated capacity of 15 cu. yds.; a 100 hp. diesel engine operates on 3 gals. of fuel per hour. Speed to 25 mph. Galion will also show a new motor grader, 46 hp., the No. 201. Also a heavy duty motor grader, several rollers, including a portable and a trench roller.

*Barrett.*—Use of Tarvia by latest and best methods for highway and street construction and repair.

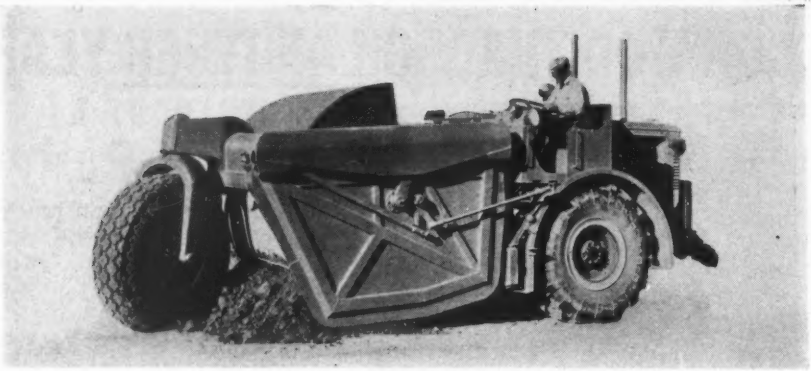
*Huber.*—Huber Mfg. Co. will show rollers, graders and the new Huber B-G road maintainer.

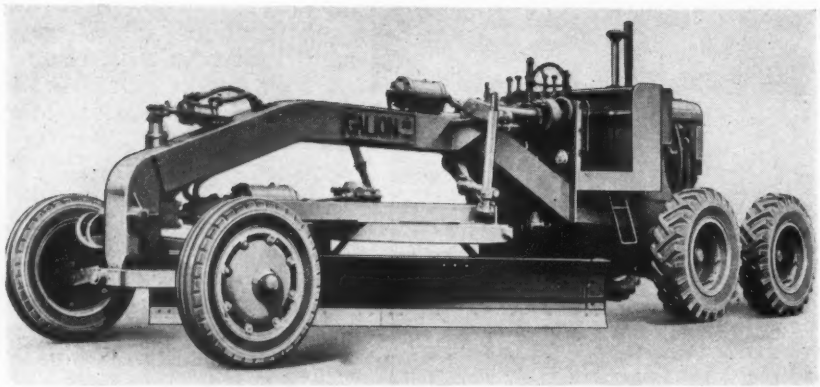
*Osgood.*—The newest 1½-yd. excavator will be exhibited by Osgood. This is a brand new machine, smooth and powerful, gas, diesel or oil.

*General.*—The Model 307 General excavator, representative of the Type 30, ½, ⅝ and ¾-yd. machines will be shown. Gas, diesel oil, or electric. Fully convertible.

*International Harvester.* — Interna-

**General type "30" shovel, available in ½, ⅝ and ¾-yd.**





**Two new Galion Models: High speed dirt mover above and Model 201 Motor Grader below. These will be exhibited for the first time at the Road Show**

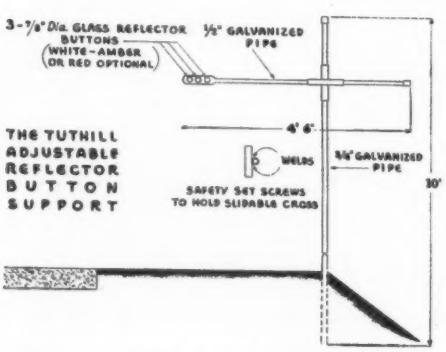
tional tractors, both wheel and crawler, and motor trucks and power unit lines will be shown. The exhibit will occupy about a quarter of an acre of space and will include some 14 tractors, 9 power unit combinations and 15 motor trucks. Also shown will be engines with parts cut away to show mechanical features, photographs and maps.

*Aeroil Burner.* — Equipment shown will include a new asphalt heating kettle, an emulsion and cut-back sprayer, surface heaters, concrete curing machines, tool heaters, weed burners and traffic control equipment.

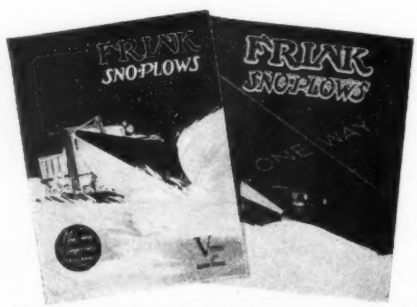
*C. H. & E.*—A 3-ton tandem roller to give a maximum compression of 140 pounds will be among the equipment shown by C. H. & E. Mfg. Co.

*Tuthill Spring Co.*—This company will exhibit in Space W-4, a new product in addition to their well known Highway Guard Rail. This is an adjustable support for glass or "Lucite" Reflector Buttons, installed along curves on highways where guard rails are not required. The support consists of a vertical pipe with a horizontal arm fastened by a sleeve fitting that permits adjustment of the Reflector vertically and horizontally.

*Calcium Chloride Ass'n.* — The exhibit of the Calcium Chloride Association in space T-4, will consist of demonstrative charts and test data on the use of calcium chloride for highway ice control, concrete curing, and for consolidation and dustproofing of unpaved roads.



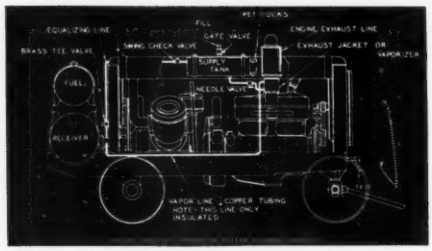

**This is the Tuthill Reflector Button Support**




**New Frink Snow Plow Catalogs, covering both V and One-Way snow plows are now available. Write Carl H. Frink, Clayton, N. Y.**

## Northrop & Company to Sell Marlow Pumps

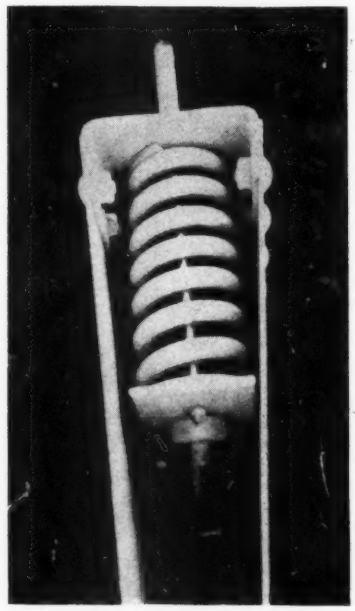
Marlow Pumps has appointed Northrop & Company, Inc., 50 Church Street, New York, N. Y., as exclusive distributors for Marlow pumps to water departments and water companies throughout the country.



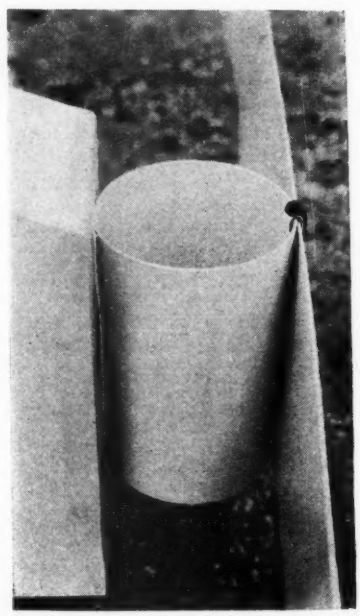
**Sullivan Portable Compressor**

## Empire Guard Rail

An excellent bulletin has been issued which describes the Empire guard rail. This rail consists of a flexible resilient



**Spring on Empire Guard Rail**



**Post Connection, Empire Guard Rail**

cushioning guard to deflect the vehicle back into the road; in addition it is highly visible. Bulletin describes design and installation. Empire Plow Co., Cleveland, O.

# Keeping Up With New Equipment

## New Highly Portable Loader

A pneumatic tired bucket loader built for fast highway towing and available in two different models has just been announced by the Barber-Greene Company, Aurora, Illinois. Model 522 B-G Loader is built as a standard machine with the usual high bucket loader boom and swivel spout, and also as a low clearance machine with a short boom and swivel conveyor.

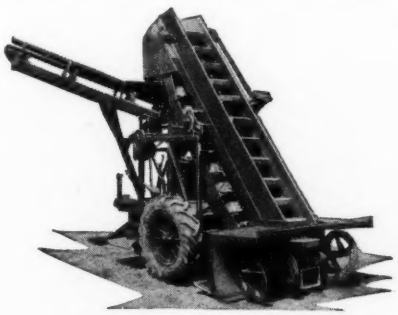
The high boom, swivel conveyor loader can be used for all typical bucket loader applications, including loading sand, gravel, and crushed stone from stock piles to trucks. It can be used by Maintenance Departments which stock

**The No. 522 Portable Loader**

pile chips on shoulders, prior to seal coat resurfacing and patching operations.

In grading and leveling operations, in landscaping, road grading, etc., bulldozers and blades deposit surplus material with no mechanical means of loading it into trucks; the 522 is used here; also for loading trucks for sanding icy pavements; it can be towed behind trucks to the local stock pile, do its job for that territory and be towed to the next.

The low clearance model has the same advantages of portability plus low clearance, plus a swivel conveyor discharge. Trucks can back under or with the conveyor swung to one side, they can drive under and continue out in the same direction. This combination opens up a wide scope of work. Dirt bladed from ditches onto the road shoulder can be loaded into trucks. The trucks drive under and out, the machine clears the branches of overhanging trees. The floating scraper gives a nice cleanup.



**Another view of the B-G Loader**

## Low Loading Height Hydraulic Hoist

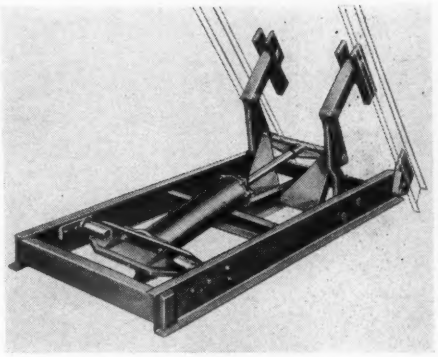
The Anthony Company of Streator, Illinois, is announcing a new hydraulic hoist, an addition to the present line. This new hoist is a double arm type lift. During the entire dumping operation the arms lift vertically to the bottom of the body. "Low loading height," which has been a feature of the Anthony line, is also a feature of this new model hoist. The bottom of the box is only 11" from the truck chassis frame, which is the minimum distance necessary for tire clearance. A "balanced" valve enables the hoist to be operated by button control on the dash.

## Applying Ozone to Water

Two booklets are available from Ozone Processes, 1500 Walnut St., Philadelphia, Pa., discussing the production of ozone, its application to water purification, the difficult conditions it is fitted for, equipment for production, costs of operation and other interesting information on this method.

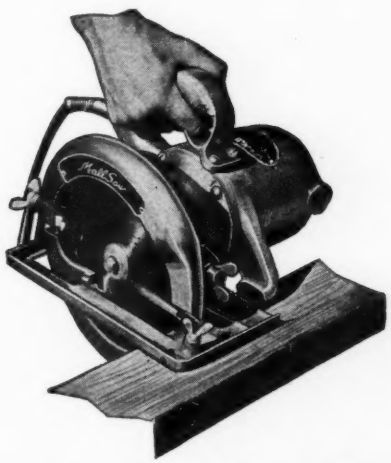
## Illinois Buys Fleet of "99's"

After having had previous experience with older Austin-Western "99" power graders, on varied construction and maintenance jobs, the Illinois State Highway Department recently purchased seventeen more of these units that drive and steer with every wheel. All were fitted with cabs, scarifiers and 13.50—20 rubber tires and eleven (11) were equipped with Austin-Western Giant "V" Snow



**New Anthony Hoist**

Plows and Snow Wings. Every adjustment of the circle and moldboard, steering and the raising and lowering of snow plow, snow wing and scarifier on these units is accomplished by hydraulic power controls from within the cab.



**New model Mall saw is electrically driven.**

## New Tapax Reel

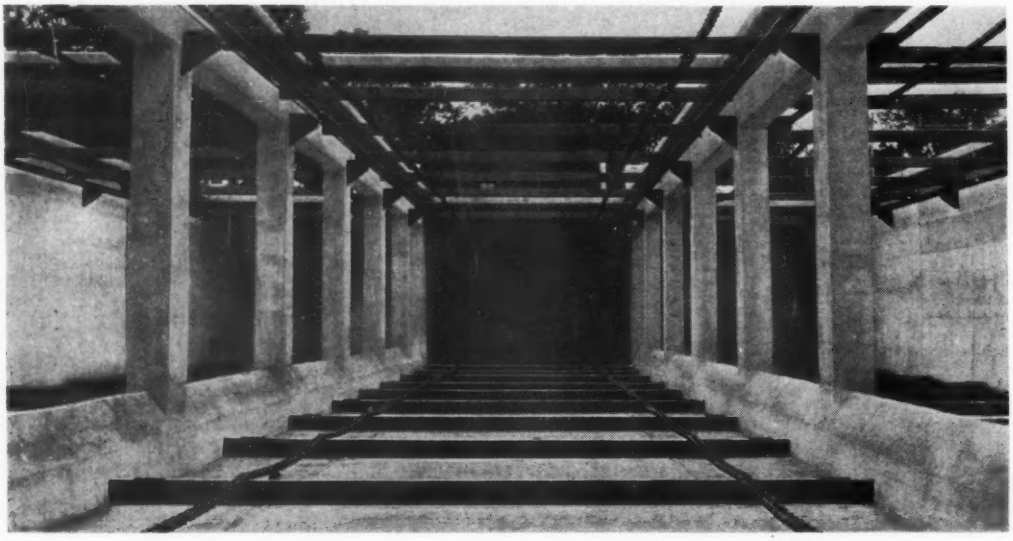
A new all-metal reel for Tapax, the manhole cover cushion, is announced by the manufacturers as "better packaging" of their product. A new folder, "The Story of TAPAX" tells all. Sent on request to Tapax Manufacturing Co., Inc., 201-203 Hoyt Avenue, Mamaroneck, N. Y.

**The fleet of Austin-Western "99's" bought by Illinois**

# STRAIGHTLINE COLLECTORS

## *for Best Results with the*

## BIOFILTRATION SEWAGE TREATMENT SYSTEM



● Much of the effectiveness of this system depends on the reactions between the filter effluent and the raw or partly treated sewage in the settling tanks.

Rectangular tanks equipped with Link-Belt STRAIGHTLINE Collectors have proved ideal for this process; giving excellent results wherever used. The California plants listed on this page, employ the Biofiltration system, with STRAIGHTLINE Collectors. Information on this system and the application of collectors of this type, will be gladly furnished.

7932

**LINK-BELT COMPANY**

Philadelphia Chicago Indianapolis Cleveland Los Angeles Atlanta Toronto

*Offices in principal cities.*

### Camarillo, Calif.

This is a complete Biofiltration plant. The two primary tanks, each of which is 10′ 0″ wide x 10′ 0″ water depth x 54′ 0″ long, are equipped with STRAIGHTLINE Collectors. The secondary tank is also equipped with two STRAIGHTLINE Collectors, each 18′ 0″ wide x 10′ 0″ water depth x 54′ 0″ long.

### Turlock, Calif.

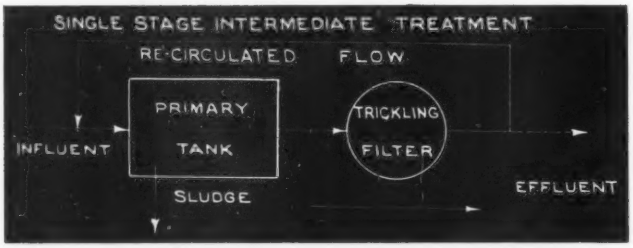
This complete Biofiltration plant employs one STRAIGHTLINE sludge collector for the primary tank—18′ 0″ wide x 12′ 0″ water depth x 68′ 0″ long—and two STRAIGHTLINE longitudinal sludge collectors and one cross collector for the final tank—37′ 0″ wide x 12′ 0″ water depth x 68′ 0″ long.

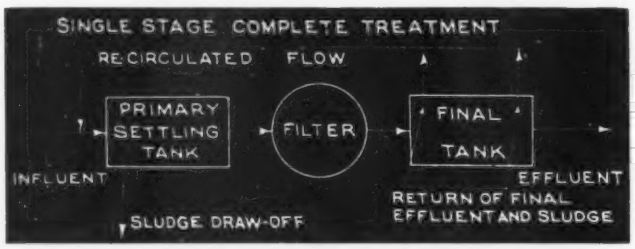
### Lakeport, Calif.

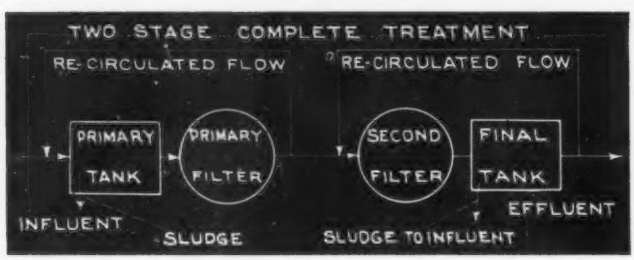
A complete Biofiltration plant with one STRAIGHTLINE Collector for the primary tank—10′ 0″ wide x 8′ 0″ water depth x 32′ 4″ long, and one STRAIGHTLINE Collector for the final tank—10′ 6″ wide x 8′ 0″ water depth x 32′ 4″ long.

### San Leandro, Calif.

While this is not a complete Biofiltration plant, it does use a small biofilter unit for the same purpose as at San Mateo, previously described. It employs three STRAIGHTLINE Collectors for the final tank, each measuring 7′ 0″ wide x 4′ 0″ water depth x 20′ 0″ long.




### San Mateo, Calif.

The large city plant for the treatment of the entire volume of sewage is of the separate sludge digestion type. A small volume of treated sewage from the settling tank flows to a small Biofiltration plant which was installed for the purpose of purifying a sufficient amount of sewage for use in irrigation and as wash water around the plant. The two settling tanks, each of which are 6′ 0″ wide and 3′ 0″ water depth x 15′ 0″ long, are equipped with Link-Belt STRAIGHTLINE Collectors.

### Placerville, Calif.

This is a complete Biofiltration plant, equipped with two STRAIGHTLINE sludge collectors for the final settling tank. Each is 16′ 0″ wide x 12′ 0″ water depth x 58′ 0″ long.

### Yountville, Calif.

This plant, which will be of the Biofiltration type, employs one STRAIGHTLINE sludge collector for the primary tank—15′ 0″ wide x 10′ 0″ water depth x 62′ 0″ long, and one STRAIGHTLINE Collector for the secondary tank—15′ 0″ wide x 10′ 0″ water depth x 62′ 0″ long.

**LINK-BELT**
SEWAGE TREATMENT AND WATER PURIFICATION PLANT
**EQUIPMENT**

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 63 to 65.

## New Blaw-Knox Road Finisher

This new finisher, which has been tested on extremely stiff concrete on the Penn Turnpike, is said to have a production rate of 250 feet of 12-ft. slab, per hour, for complete 8-hour turns. The finisher is gasoline engine driven, with double screeds. All functions of the machine are handled through a unit transmission. Speed of screed stroke is synchronized with the speed of the machine. Screeds are 9 and 12 ins. wide. Full details from Blaw-Knox Co., Blawnox, Pa.

Blaw-Knox Finisher working on stiff concrete

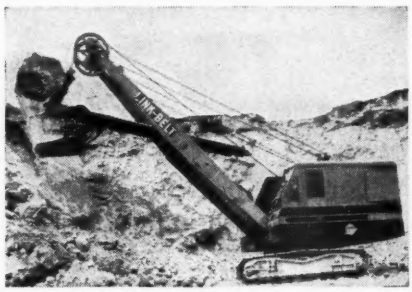
## Traffic Line Marker and Paint Sprayer

Meili-Blumberg Corp., New Holstein, Wisc., has issued a new bulletin describing a new traffic line marker and all-purpose paint sprayer. Illustrations and text show methods of use; brief specifications are given.

The Coffing Chain Hoist, Coffing Hoist Co., Danville, Ill.

## 9.6-Mile Belt Conveyor on Shasta Dam

There is shown herewith an artist's sketch of the biggest-in-the-world belt conveyor system to be used in connection with the building of the Shasta Dam. This conveyor system will furnish the aggregate, and another system, a mile long, will handle the cement. Goodyear Tire & Rubber Co. will furnish the belting, about 20 miles of 36-inch wide material being required. Chain Belt Co. will furnish the 16,000 idlers. The conveyor system will be erected on wooden bents from 4 to 90 feet high and will be composed of 26 separate links, each powered by a 200 hp. motor.




New Link-Belt Speeder Shovel

## Hough Tractor Sweeper

A stream-lined, attractive unit for sweeping skating ponds, sidewalks, ramps, platforms and similar work is announced by Frank G. Hough Co., Libertyville, Ill. Cleans a 5-ft. path; weighs about 1,000 pounds; uses an Allis-Chalmers tractor. Bulletin No. 115 describes this unit more fully.

## Caterpillar 90-Horsepower Diesel Truck Engine

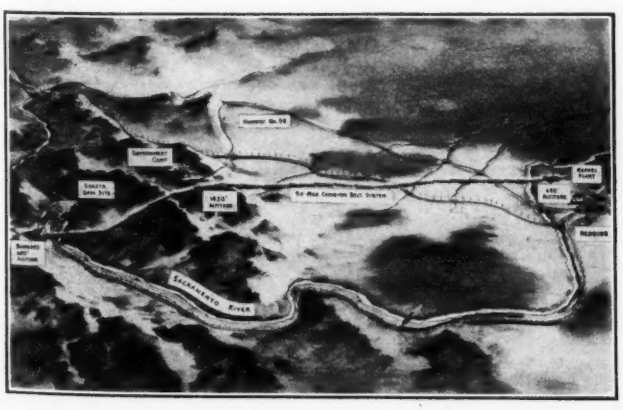
Caterpillar Tractor Co., Peoria, Ill., has announced a new 6-cylinder, 90 hp. diesel engine for use in trucks. Piston displacement is 468 cu. ins.; maximum power is attained at 1800 rpm. Diesel engines have shown remarkable economy in operation of construction and maintenance equipment, and have been used in trucks in a number of cases. Fuller information from the manufacturer.

## Highly Accessible Contractors' Centrifugal Pump.

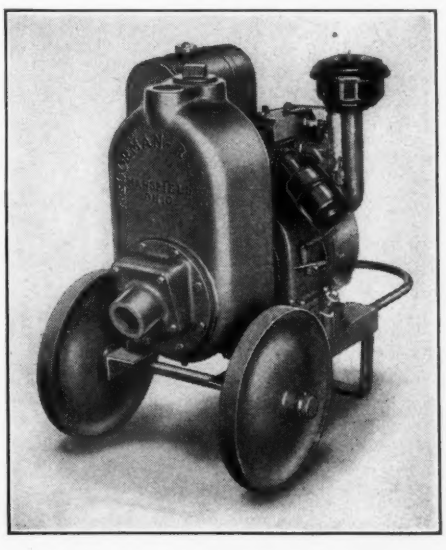
Among the pumps that will be displayed by the Gorman-Rupp Company, Mansfield, Ohio, at the Road Show will be a new contractors' heavy duty self-priming centrifugal pump that is said to be a revelation in accessibility. By removing the suction coupling the impeller can be withdrawn from the pump without unfastening any other plates or parts.

This new pump will be made in the standard heavy duty sizes of 2" 10M, 3" 20M, 4" 40M, 6" 90M and 8" 125M, all sizes being mounted on disc wheels as shown. In all sizes, it is streamlined and presents a most pleasing appearance.

The Gorman-Rupp Company will also exhibit its complete line of four lightweight aluminum pumps; four models of standard duty contractors' self-priming centrifugals; one Model R125-500 Triplex Road pump and a new model single stage auto prime jetting pump which is made in two sizes. In all a total of sixteen pumps will be exhibited.



Left, Artist's sketch of 9.6-mile conveyor



Right, Accessible Contractors' Pump

## Highway Officials of the North Atlantic States

The 16th annual convention of this association will be held at Atlantic City, N. J., Feb. 14, 15 and 16. Convention headquarters will be at the Ambassador. A. Lee Grover, State Highway Department, Trenton, N. J., is secretary.

## 25th Meeting of New Jersey Sewage Works Ass'n.

Big doings are planned to celebrate the 25th anniversary of the New Jersey Sewage Works Ass'n., which will be held at Trenton, N. J., March 20-22. Details of the program have not been announced as yet, but it is intended to have a program of national scope, with well-known engineers from all over the country present. William J. Orchard is chairman of the Silver Anniversary Committee; Paul Molitor, Jr., is president of the Association and chairman of the Publicity Committee, of which Anthony Anable of the Dorr Co. is vice-chairman.

## Treatment Trailer Has Pups

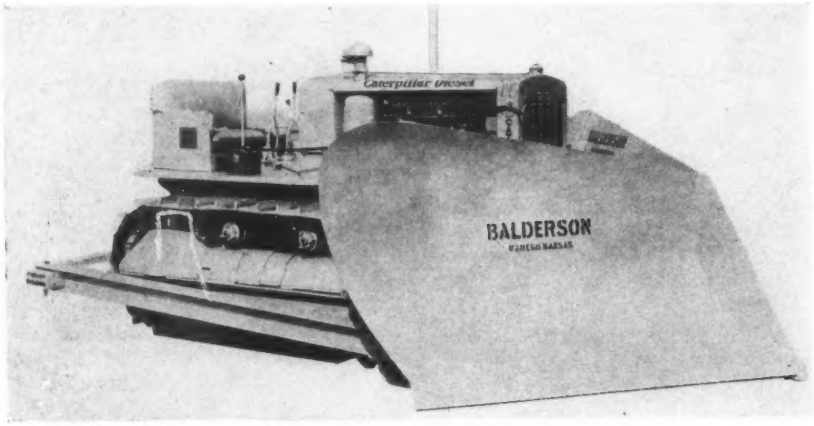
So runs the statement issued by Proportioneers, Inc., Providence, R. I., in reference to the new "blue car" that Alan A. Wood, of Philadelphia, Pa., has devised to take the story to Pa., Va., Md. and N. J. It contains operating exhibits of chemical feeding apparatus; registering, indicating and recording equipment of the Venturi type; and other equipment.

## Armco Drainage Products Association

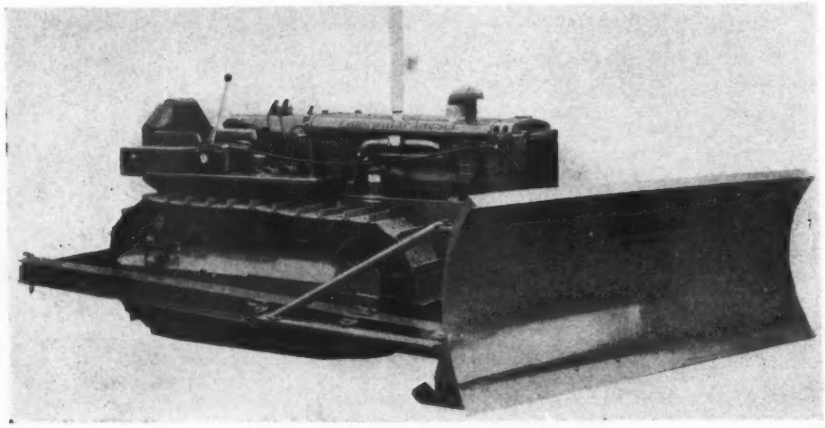
Changing trends in business has led the Armco Culvert Mfrs. Ass'n, Middletown, O., to change its name to Armco Drainage Products Association. During the past few years many products have been added to the original corrugated metal culverts. These new products include: perforated corrugated drainage pipe, asbestos bonded paved invert pipe for sewers, multi-plate pipe and arches for small bridges, drainage gates, metal retaining walls, culvert headwalls, flumes, sheet piling, tunnel liner plates and spiral welded smooth wall pipe.

## Balderson Snow Plows

The Balderson Mfg. Co., Wamego, Kansas, manufactures V and reversible snow plows for Caterpillar track type tractors, V plows for the Caterpillar auto patrols, one-way sidewalk plows for the lighter tractors and V and one-way plows for all types of trucks. Balderson plows have adjustable shoes, standard cutting edges, hydraulic controls and arc welded construction. This company will exhibit at the Road Show this year for the first time and will display a heavy V plow for tractor use and a reversible blade plow for medium use.




**The Balderson V-40 Snow Plow**



**The Balderson R-30 Blade Snow Plow**

## Construction Costs:

Bids on the Boulder-Cardwell Road in Montana: Unclassified excavation, 85,715 cubic yards. Low bidder, J. W. Merz, Helena, Mont., 24c; average of five low bidders, 28.6c. Structure excavation, 1,256 cu. yds., three low bidders $1; average of five low bidders, $1.20. Overhaul, 8,901 mile-yds., low bid 1c; average next five bidders, 15.8c.

Kalispell - Libby Road, Montana; Union Construction Co., Great Falls, low bidder. Unclassified excavation, 7,331 cu. yd., 25c; pit run gravel, 8,962 tons, 40c; grade A top course gravel, 23,740 tons, 65c; stone chips, 3,304 tons, $3; watering, 420,000 gals., $1.50 per M; rolling sub-base, cushion and chips, 300 hrs., $4; applying SC-4 road oil, 227,-106 gals., 8½c; processing, 14.067 mi., $650; seal coat oiling, SC-95 oil, 55,516 gals., 12c.

Heber Main St., Utah: W. W. Clyde & Co., Springville, low bidder. SC-3 bituminous material, 39,200 gals., 6c; RC-2 seal coat bituminous material, 4,500 gals., 9c; gravel or crushed stone base course, 4,700 tons, 37c; crushed rock or gravel surface course, 9,400 tons, 40c; scarifying and mixing, 0.686 mile, $1,200; unclassified excavation, 11,000 cu. yds., 20c; overhaul, class A, 76,000 station yds., 1c; rolling, 170 hours, $2.50.

## National Paving Brick Association

The 34th annual meeting of the National Paving Brick Ass'n will be held in Chicago, Ill., Jan. 30 and 31, 1940, at the Congress Hotel. Business meetings will be held on the first day, while the second day sessions will be open to the public. The program will include papers and discussions by engineers and contractors on the use of brick in paving, covering both recent developments in manufacturing and improvements in construction practices. C. C. Blair of the Metropolitan Paving Brick Co., Canton, O., is president of the Association.

## New York State Sewage Works Ass'n

The 12th annual meeting of this association will be held in New York, at the McAlpin Hotel, Jan. 17 to 20. As usual, meetings will be held in conjunction with the sanitary engineering section of the American Society of Civil Engineers. Full details of the program are not yet available, but may be obtained from A. S. Bedell, State Department of Health, Albany, N. Y.

## American Society of Civil Engineers

The 87th annual meeting of this society will be held in New York at the society headquarters January 17-20. A detailed program covering the various sessions will reach all members soon; others may obtain a program by writing the ASCE at 33 West 39th St., N. Y.